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Introduction

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02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. 2250

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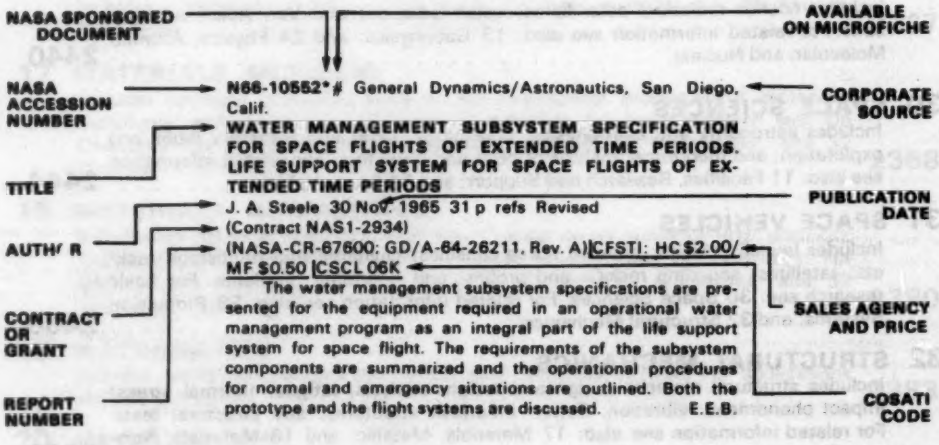
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N66-10552*# General Dynamics/Astronautics, San Diego, Calif.
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TITLE
WATER MANAGEMENT SUBSYSTEM SPECIFICATION FOR SPACE FLIGHTS OF EXTENDED TIME PERIODS. LIFE SUPPORT SYSTEM FOR SPACE FLIGHTS OF EXTENDED TIME PERIODS
PUBLICATION DATE
J. A. Steele 30 Nov. 1965 31 p refs Revised
AUTHOR
(Contract NAS1-2934)
CONTRACT OR GRANT
(NASA-CR-67600; GD/A-64-26211, Rev. A) CFSTI: HC $2.00/MF $0.50 CSCL 06K
SALES AGENCY AND PRICE
The water management subsystem specifications are presented for the equipment required in an operational water management program as an integral part of the life support system for space flight. The requirements of the subsystem components are summarized and the operational procedures for normal and emergency situations are outlined. Both the prototype and the flight systems are discussed.
REPORT NUMBER
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VOLUME 4 NUMBER 13

Scientific and Technical Aerospace Reports

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July 8, 1966

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N66-23898# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).

LAMINAR SEPARATION IN SUPERSONIC AND HYPERSONIC FLOWS Final Report, 1 Nov. 1964–31 Oct. 1965

Jean J. Ginoux Oct. 1965 32 p refs

(Grant AF-EOAR-65-11)

(AROSR-65-2715; AD-628182) CFSTI: HC $3.60/MF $0.50

High speed two-dimensional reattaching flows are characterized by the development of regularly spaced vortices in the boundary layer, whose effect is to produce heat transfer rates at reattachment which are, locally over the span, considerably higher in laminar and transitional flows than in the turbulent case. These results are expected to occur both at supersonic and hypersonic speeds, as these vortices were observed over a range of Mach numbers of 1.5 to 7.0. A basic difference in the recovery of total energy at reattachment and decreased to the laminar theoretical value in a region downstream of reattachment, where the flow was turbulent. The aerodynamic heating of sweptback wings can be predicted by a simple method derived from flat plate theory and by superimposing flow components parallel and perpendicular to the leading edge. Streamwise vortices do not seem to affect the average heat transfer coefficient.

Author (TAB)

N66-23994# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

NEWS OF INSTITUTIONS OF HIGHER LEARNING. AERONAUTICAL ENGINEERING, NO. 4, 1963 Collection of Articles

6 Jan. 1966 267 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekh. (Kazan), no. 4, 1963 p 1–186

(FTD-MT-64-276; AD-629441) CFSTI: HC $26.30/MF $1.25

Translations of Russian articles on aeronautical engineering, thermodynamics, fluid dynamics, and aircraft structural parts are presented. For individual titles see N66-23995–N66-24016.

N66-23995# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ENTRY OF A WINGED AIRCRAFT INTO VERTICAL GUST OF AIR

Yu. A. Val'kov *In its* News of Inst. of Higher Learning 6 Jan. 1966 p 1–16 refs (See N66-23994 13-01) CFSTI: HC $26.30/MF $1.25

Consideration is given to the problem of a winged aircraft entering into a vertical gust of air. Two cases are considered; one in which the gust is of short duration, and one in which the initial disturbances lie on the boundary region of stability. Details of the formulation and solution methods are given, and various graphs and diagrams to aid in portraying the assumptions and results are included.

C.T.C.

N66-23996# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON SELECTION OF OPTIMUM CONTROL OF AIRCRAFT

Yu. V. Kozhevnikov *In its* News of Inst. of Higher Learning 6 Jan. 1966 p 17–30 refs (See N66-23994 13-01) CFSTI: HC $26.30/MF $1.25

An attempt is made to obtain general results to problems concerned with optimizing aircraft flight conditions. The results are made general by the addition of motion equations defining the aircraft center of mass, equations describing the mass near the center, and by applying the maximum principle of Pontryagin. The formulation of the problem is detailed, conditions of optimization are given, and the selection of optimization, including stepped and special control, is discussed.

C.T.C.

N66-24012# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF CHARACTERISTICS OF GUIDE APPARATUS ON DEVELOPMENT OF ROTATING STALL IN IMPELLER OF AN AXIAL COMPRESSOR

Tsung-liang Chu *In its* News of Inst. of Higher Learning 6 Jan. 1966 p 208–218 refs (See N66-23994 13-01 CFSTI: HC $26.30/MF $1.25

A solution is given for the speed of the rotation of stall zones, in the presence of a guiding device, in the impeller of an axial compressor. A previously devised theory of small perturbations was used as a basis for the calculations, however this theory was expanded to include the friction loss in the ducts between the blades and the influence of vorticity, beyond the working cascade, on the air flow. The mathematical relationships are derived and the results of experiments that were conducted to confirm these mathematical considerations are assessed.

H.S.W.

N66-24469# Martin Co., Baltimore, Md.
CONSIDERATIONS IN THE DESIGN OF VEHICLES CAPABLE OF SUBSTANTIAL HYPERSONIC LIFT-DRAG RATIOS
S. H. Masien Dec. 1965 54 p refs Revised
(RR-54)

The problem of generating a significant hypersonic lift-drag ratio is attacked with Newtonian theory and a simple laminar boundary layer analysis, the relevance of which is discussed. Keeping in mind the restraints arising from high local heating rates and by the need to carry a reasonable payload, some consequences of bluntness, swept edges, fins and nonlifting sides are examined. A number of numerical examples are given which show the gains to be made by reducing the bluntness, increasing the sweep of edges and minimizing the size of various nonlifting surfaces, such as sides and fins. Some consequences of heating and trajectory considerations are also considered briefly. Author

N66-24475# North American Aviation, Inc., Los Angeles, Calif.
OPEN NOSE INLET ADDITIVE DRAG TEST RESULTS AT SUBSONIC AND TRANSONIC SPEEDS
M. W. Petersen and G. C. Tamplin 9 Dec. 1964 112 p refs
(NA-64-921)

This report contains the analyses of wind tunnel data from a subsonic and transonic additive drag test of five open nose inlets. Additive drag correction factors for the five inlets were found to be strongly dependent upon inlet geometry. They vary from 0% to approximately 80% of the theoretical additive drag, depending upon geometry, Mach number and mass-flow-ratio. The importance of adequate additive drag data to future multiple design point vehicles, especially those utilizing fan engines, is pointed out. Author

N66-24597*# Rice Univ., Houston, Tex.
SIMILARITY LAWS FOR LIFTING BODIES OF MINIMUM DRAG AT HYPERSONIC SPEEDS
Angelo Miele 1965 29 p refs
(Grant NGR-44-006-034)
(NASA-CR-74621; AAR-11) CFSTI: HC $2.00/MF $0.50
CSCL 01A

The problem of determining the longitudinal and transversal contours minimizing the drag of a flat-top body in hypersonic flow is considered under the hypotheses that the pressure distribution is Newtonian and the skin-friction coefficient is constant. Two similarity laws are determined. The similarity law for longitudinal contours permits one to determine the optinum longitudinal contour of a body of arbitrary transversal contour from the known optimum longitudinal contour of a reference body (a body of semicircular cross section); the aerodynamic and geometric quantities of the latter must be replaced by appropriate proportional quantities of the former, with the proportionality constants depending only on the prescribed transversal contour. The similarity law for transversal contours permits one to determine the optimum transversal contour of a body of arbitrary longitudinal contour from the known optimum transversal contour of a reference body (a conical body); the aerodynamic and geometric quantities of the latter must be replaced by appropriate proportional quantities of the former, with the proportionality constants depending only on the prescribed longitudinal contour. Author

N66-24608*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CALCULATED BLADE RESPONSE AT HIGH TIP-SPEED RATIOS
Julian L. Jenkins, Jr. *In* NASA. Ames Res. Center Conf. on V/STOL and STOL Aircraft 1966 p 17-27 (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

The initial results are presented of a digital computer study of helicopter rotor-blade-motion stability for a broad range of forward speeds encompassing proposed conventional and compound helicopter designs. The analysis treats the general case of nonlinear, coupled flapping and lagging motions of hinged rigid blades. The results indicate that blade-motion stability boundaries cannot be specified for a given blade design in terms of a fixed value of rotor tip-speed ratio. The stability boundaries can shift significantly within the desired operational speed range, with the stability limits depending upon the rotor loading, the magnitude of the disturbance encountered by the blade, and the blade position at the instant the external disturbance is encountered. The sample methods suggested for improving blade-motion stability include increasing the effective hinge spring restraint by incorporating pitch-flap coupling or by using hingeless or teetering rotor systems. Reducing rotor loading also has a beneficial effect on the blade-motion stability. The results indicate that methods used to deal with the blade-motion stability problem can be expected to diminish the overall vibration levels of the helicopter rotor system across the entire design speed range. Author

N66-24609*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PERFORMANCE CHARACTERISTICS OF A JET-FLAP ROTOR
John L. Mc Cloud III, William T. Evans, and James C. Biggers *In its* Conf. on V/STOL and STOL Aircraft 1966 p 29-40 refs (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

Results of an experimental investigation of the characteristics of a jet-flap rotor are presented and discussed. Comparisons of the rotor's force-producing capabilities with those of a conventional rotor are made which show the jet-flap rotor to be operable well beyond standard rotor stall boundaries. Correlations are made between measured and calculated results which show generally good agreement. Author

N66-24610*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DESCENT CAPABILITY OF TWO-PROPELLER TILT-WING CONFIGURATIONS
James L. Hassell, Jr. and Robert H. Kirby NASA. Ames Res. Center Conf. on V/STOL and STOL Aircraft 1966 p 41-50 refs (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

The wing stall problem encountered with tilt-wing V/STOL designs during low-powered descent flight conditions has led to buffeting which adversely affects both performance and handling qualities. The results of tests conducted in a full-scale wind tunnel with a large semispan model of a two-propeller tilt-wing configuration have indicated that three important factors provide substantial improvement in the wing stall characteristics with consequent improvement in descent capability: down-at-center propeller rotation resulted in delayed inboard stalling and provided far better descent capability than the up-at-center rotation; moderate lowering of the propeller position relative to the wind chord provided further improvement in descent capability; and some flap deflection was absolutely essential in order to have any descent capability for low-powered flight conditions. Use of all three factors should provide good descent capability even without the complexity of other sophisticated stall control devices. Author

N66-24612*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A SUMMARY OF RECENT LARGE-SCALE RESEARCH ON HIGH-LIFT DEVICES

Wallace H. Deckert, David G. Koenig, and James A. Weiberg *In its* Conf. on V/STOL and STOL Aircraft 1966 p 63–79 refs (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

A brief summary of recent 40- by 80-foot wind-tunnel investigations of large-scale models equipped with various high-life devices is presented. The basic high-lift concepts investigated were the externally blown flap, the augmentor wing, and the rotating-cylinder flap. The scope is limited to a discussion of the wind-tunnel results in terms of maximum life, descent performance, and pitch trim requirements. Author

N66-24614*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SUMMARY OF LARGE-SCALE TESTS OF DUCTED FANS

Kenneth W. Mort *In its* Conf. on V/STOL and STOL Aircraft 1966 p 97–113 refs (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

Several research areas on large scale isolated ducted fan models are discussed. Research concerned with performance has indicated that: (1) ducted fan inlet design does not appear to be a major problem; (2) ducted fan nacelles must be very carefully designed, otherwise the drag becomes excessive; and (3) increasing fan tip clearance reduces the shroud thrust and reduces the capability of the fan for absorbing power. Research concerned with the occurrence of duct lip stall due to angle of attack indicates that neither inner nor outer duct lip stall for reasonably sized ducted fans is a major problem. Author

N66-24631*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

WIND-TUNNEL BOUNDARY INTERFERENCE FOR V/STOL TESTING

Harry H. Heyson and Kalman J. Grunwald *In* NASA. Ames Res. Center Conf. on V/STOL and STOL Aircraft 1966 p 409–434 refs (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

The adequacy of current aerodynamic theory to predict the effects of the wind tunnel boundary interference on the data from specific models was experimentally investigated. In addition, some information is presented on the degree of relief from corrections which can be obtained by appropriate slotting and opening of the wind tunnel walls. The following conclusions were reached: Because of the large scale recirculation effects, there is a finite lower limit to the test speed at which reliable and correctable data can be obtained in closed wind tunnels. Although a zero-correction wind tunnel for V/STOL testing has not yet been achieved, it is shown that the use of suitably mixed wind tunnel boundaries can alleviate boundary effects on V/STOL data. D.T.

N66-24633*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

COMPARISON OF WIND-TUNNEL AND FLIGHT TEST AERODYNAMIC DATA IN THE TRANSITION-FLIGHT SPEED RANGE FOR FIVE V/STOL AIRCRAFT

Woodrow L. Cook and David H. Hickey *In its* Conf. on V/STOL and STOL Aircraft 1966 p 447–467 refs Presented at AGARD Flight Mech. Panel, Rome, 12 Oct. 1965 (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

Four aircraft and one large-scale model which represent the V/STOL spectrum from low-disk-loading rotocraft to high-disk-loading lift-fan systems have been studied in a 40- by 80-foot wind tunnel. In general, the aircraft were tested in the tunnel near trimmed, level-flight conditions. The power required, angle of attack, and control positions for the appropriate flight conditions as measured in the wind tunnel are compared with flight-test results. Agreement between wind-tunnel and flight test measurements was generally good when wind-tunnel wall corrections were omitted. The aircraft and wind-tunnel geometry is related to wind-tunnel model sizing parameters and a VTOL lift parameter in order to establish tentative sizing criteria for V/STOL wind-tunnel testing with small wall effects. Author

N66-24634*# National Aeronautics and Space Administration, Washington, D. C.

HYPERLIFT AND BALANCING OF SLENDER WINGS [HYPERSUSTENTATION ET EQUILIBRAGE DES AILES ELANCEES]

Philippe Poisson-Quinton and Emile Erlich Aug. 1965 76 p refs Transl. into ENGLISH of a French paper presented at the ONERA Colloq. of Appl. Aerodyn., Paris, 12–13 Nov. 1964 (NASA-TT-F-9523) CFSTI: HC $3.00/MF $0.75 CSCL 01A

The problems encountered in the design and subsonic flight of supersonic transports (SST) are reviewed and calculated for slender wings, canard-type aircraft, and delta wings with and without fuselage, with and without front and aft empennage. The use of pressure-side flaps, positioned so as to avoid nose heaviness, is critically evaluated. The hyperlift created by vortex trails shed from the wing tips is used for modifying the design so as to improve the takeoff and landing characteristics. Variable sweepback by use of retractable tail units permits life increment at low speeds and better performance at Mach 2 and 3. Performance graphs for all possible designs are given. Author

N66-24659# Library of Congress, Washington, D. C. Aerospace Technology Div.

INVESTIGATIONS IN SOVIET HYPERVELOCITY TESTING TECHNIQUE Surveys of Communist World Scientific and Technical Literature

Alexis Baratoff 16 Dec. 1965 92 p refs (ATD-65-114)

This comprehensive report is based on Soviet satellite open sources published 1924–1965. It concerns experimental research in high velocity aerodynamics and gas dynamics. The first section lists facilities and personnel engaged in this field of research; it gives data on wind tunnels, shock tubes, and shock tube flows; a third chapter pertains to measurement techniques. The second section deals with such problems of aerophysics as the state of a gas heated by a shock wave and related phenomena taking place behind a shock wave, such as dissociation, ionization, light emission, radiation, and formation of plasma. It includes shock tube flows, boundary layer interaction, physical properties of gases at high temperatures, heat transfer, mass transfer, and detonation. The research is based on simulation of the conditions encountered in space flights and reentry by creating high speed, high temperature ionized gas flows by means of shock waves produced in supersonic wind tunnels, shock tubes, discharge tubes, and by explosions. Emphasis has been placed on supersonic shock tube investigations. The shock wave methods employed in laboratory studies of the physical and physicochemical properties of various gases heated by shock waves at high temperatures, the specific apparatus, and the auxiliary means characteristic of many laboratories are described. Author

N66-24745# Boeing Co., Morton, Pa. Vertol Div.
INVESTIGATION OF AN ISOLATED MONOCYCLIC V/STOL PROPELLER PERFORMANCE AND OSCILLATORY STRESS
R. W. de Decker Fort Eustis, Va., Army Aviation Materiel Labs., Feb. 1966 122 p refs
(Contract DA-44-177-AMC-319(T))
(USAAVLABS-TR-65-80; AD-629647) CFSTI: HC $12.60/MF $0.75

Test results confirmed: (1) that there is an apparent phase shift of the monocyclic axis at high collective angle, caused by hysteresis in the airfoil's stall characteristics, and (2) that there is an increase in side force as collective angle is increased, caused by a nonlinear variation in airfoil drag with cyclic pitch. The monocyclic propeller test program also included investigation of the effects of control system stiffness on xhb dynamic response of the propeller and control system. The results indicate that the use of cyclic-blade-pitch control reduces the harmonic content of control system oscillatory loads to basically a first-harmonic response. Higher harmonic loads are present, but their amplitudes are less than 10 percent of the resultant peak-to-peak load, and are therefore considered negligible. The results of the program also indicate that the increase of control system stiffness resulted in an increase in blade-pitch-link oscillatory loads. TAB

N66-24826# Aerodynamische Versuchsanstalt, Gottingen (West Germany).
AERODYNAMIC INVESTIGATIONS OF CONES IN THE HYPERSONIC MACH NUMBER RANGE [AERODYNAMISCHE UNTERSUCHUNGEN AN KEGELN IM HYPERSONISCHEN MACHZAHLBEREICH]
Th. Hottner 15 Dec. 1964 83 p refs In GERMAN
(Rept.-64-A-48) CFSTI: HC $3.00/MF $0.75

Circular conic bodies of revolution, moving at hypersonic speeds of Mach 3 to 5.68, were measured for their normal force, tangential force, and pitching moments at 10° angle of attack in a wind tunnel. Obtained total resistance values were adjusted to the friction and wake parameters, and the difference between pressure onset and final pressure obtained was calculated to find the time lack characteristics of the wind tunnel mechanism. Measured values showed good agreement with the calculated results.
Transl. by G.G.

N66-24832# National Aeronautical Lab., Bangalore (India).
INVESTIGATIONS ON VORTEX FLOWS
Y. V. G. Acharya, K. Krishnamurthy, and P. A. Irani Sep. 1965 58 p ref
(TN-AE-28-65) CFSTI: HC $2.00/MF $0.50

A tunnel was designed and fabricated at the NAL, the salient features of the tunnel being a vertical duct fabricated from perspex for flow visualization and a cascade of entrance vanes with a mechanical device which can be operated so that all the vanes rotate simultaneously to effect a required incidence. One can obtain a purely axial flow or a helical flow in the tunnel. The report describes the results of flow investigations in the NAL vortex tunnel at 15° vane angle. A reversal of flow has been observed. Increasing the vane incidence moved the reversal of flow region upstream. This movement is consistent with the behavior of the burst of a leading edge vortex, when the strength of the vortex is increased by raising the incidence. It has now been observed that the boundary layer growth on the wall of the tunnel was similar to that obtained by Y.V.G. Archarya in the JHU Tunnel. The investigations in the JHU tunnel are also reported in this note. The results obtained in the NAL nad JHU tunnels have been compared and the agreement is satisfactory.
Author

N66-24925*# National Aeronautics and Space Administration, Washington, D. C.
SUPERSONIC FLOW AROUND ELLIPSOIDS [OBTEKANIYE ELLIPSOIDOV SVERKHZVUKOVYM POTOKOM]
A. P. Shvets May 1966 12 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 4, 1964, p 29-32
(NASA-TT-F-10179) CFSTI: HC $1.00/MF $0.50 CSCL 01A

Experimental investigations of supersonic flow around ellipsoidal models and the position of the detached shock waves are described. Tests were conducted in an intermittent wind tunnel at Mach numbers from 1.48 to 3.02. The test models were oblate ellipsoids of revolution with semi-axis ratios from 0.19 to 0.49. Approximate calculation of the aerodynamic performance curves was carried out on the basis of pressure distribution over the contour of one section of the model in the plane of the angle of attack. The pressure distribution, drag, and flow spectra data are given in graph form. The variation of the tangential force coefficient, the normal force coefficient dependence on the angle of attack, and the effect of ellipsoid flattening, the shape and position of the bow wave, and theoretical and experimental data on the detachment of a compression shock are also shown in graphs. N.E.N.

N66-24999*# Rice Univ., Houston, Tex.
POWER-LAW BODIES OF MAXIMUM LIFT-TO-DRAG RATIO IN HYPERSONIC FLOW
Angelo Miele and Ho-yi Huang 1966 37 p refs
(Grant NGR-44-006-034)
(NASA-CR-74732; AAR-20) CFSTI: HC $2.00/MF $0.50 CSCL 01A

The problem of maximizing the (L/D) ratio of a slender, flat-top, hypersonic body is investigated under the assumptions that the pressure distribution is Newtonian and the skin-friction coefficient is constant. Direct methods are employed, and the analysis is confined to the class of bodies whose transversal contour is semicircular and whose longitudinal contour is a power law. First, unconstrained configurations are considered, and the combination of power law exponent and thickness ratio maximizing the L/D ratio is determined. For a friction coefficient $C_f = 10^{-3}$, the maximum L/D ratio is $E = 3.6$ and corresponds to a conical configuration of thickness ratio $\tau = 0.118$. Next, constrained configurations are considered, that is, conditions are imposed on the length, thickness, volume, and position of the center of pressure. For each combination of constraints, an appropriate similarity parameter is introduced; and the optimum power law exponent, thickness ratio, and L/D ratio are determined as functions of the similarity parameter. Author

N66-25159*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
AN INVESTIGATION AT MACH NUMBERS FROM 0.40 TO 1.00 OF A MODEL WITH A WING HAVING INBOARD SECTIONS CAMBERED FOR MACH 1.2
Richard J. Re and Gunars Stumbris Washington, NASA, May 1966 41 p refs
(NASA-TN-D-3419) CFSTI: HC $2.00/MF $0.50 CSCL 01A

The longitudinal aerodynamic characteristics of a wing-body-tail combination with a wing designed for high efficiency at high subsonic speeds have been determined. The wing had a leading-edge sweep discontinuity at the midsemispan and was cambered for a lift coefficient of 0.4. The camber lines were calculated by using linearized theory and assuming a Mach number of 1.2 for the inboard section and a Mach number of 1.0 for the outboard section. Other model components

were a cylindrical body with an ellipsoidal nose, horizontal and vertical tails, and wing fences. Model forces and moments were determined for Mach numbers from 0.40 to 1.00 at angles of attack in the range −5° to 15°. The Reynolds number of the tests based on wing reference chord varied from 1.9×10^6 to 3.1×10^6. Boundary-layer transition was fixed for all model configurations. When compared with a similar wing-body combination, the wing-body combination of the present investigation showed an improvement in drag due to lift at Mach numbers from about 0.80 to 0.90. Streamwise fences at the wing leading-edge sweep discontinuity reduced the nonlinearity of the pitching-moment curves of the wing-body-tail combination at high lift coefficients. Author

N66-25189# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Abteilung Flugmechanik Der Vertikalstartflugzeuge.

CALCULATION OF THE BENDING OSCILLATIONS OF A ROTOR BLADE WITH HINGE-CONCENTRATED MASSES [BERECHNUNG DER BIEGESCHWINGUNGEN EINES ROTOR BLATTES MIT MASSENGELENKEN]

H. Oette Dec. 1965 64 p refs In GERMAN; ENGLISH and FRENCH summary

(DLR-FB-65-54; DFL-75) CFSTI: HC $3.00/MF $0.75

A rotor blade performing one-dimensional bending oscillations is divided in a system of n oscillating singular masses. Between them are rigid, massless bars connected at the location of the masses by spring-joints. The n differential equations of motion are derived from the equilibrium of forces for every singular mass. Hereby less calculation work is necessary than by other methods, where the equilibrium of moments relating to every joint is used. It is possible to treat every type of blade with any, even aperiodic type of aerodynamic loadings. Also natural modes of oscillation and frequencies can be found which are necessary for several other methods. Author

N66-25200# Royal Aircraft Establishment, Farnborough (England).

THE EXTERNAL DRAG OF SOME PITOT-TYPE INTAKES AT SUPERSONIC SPEEDS: PART I

L. E. Fraenkel London, Min. of Supply, Jun. 1950 31 p refs (RAE-2380) (Declassified)

Four pitot intake models have been tested in a 9×9 inch tunnel at Mach numbers of 1.41, 1.61, and 1.82. The external drag of the models, which have different inlet areas and cowl lip shapes, has been measured over a range of mass flows. A simple theory has also been developed to predict the considerable increase in external diffuser drag which results from reducing mass flow below the maximum value. The experimental results are in fair agreement both with this theory and with the linearized method of calculating the drag of a pitot intake at full mass flow. Author

N66-25225# Aeronautical Research Council (Gt. Brit.)

SLENDER-BODY THEORY CALCULATIONS OF THE EFFECT ON LIFT AND MOMENT OF MOUNTING THE WING OFF THE FUSELAGE CENTER-LINE

R. S. Bartlett 1965 56 p refs Supersedes ARC-25-965 (ARC-CP-830; ARC-25-965) CFSTI: HC $3.00/MF $0.50

Slender-body theory is used to calculate the effects on lift and moment of mounting the wing of a wing-body combination above or below the body axis, with and without wing-body angle. The wing must have a local span which increases in the downstream direction, an unswept trailing edge and uncambered cross-sections. The cross-sections of the body are assumed to be circles of constant radius over the length of the wing. It is found that the effects of the asymmetrical mounting are substantial when the body diameter is more than half the wing span, but fall off as the body shrinks. For a typical aircraft configuration, the pitching moment is found to be more affected than the lift. Author

N66-25249*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

A DIRECT METHOD FOR CALCULATION OF THE FLOW ABOUT AN AXISYMMETRIC BLUNT BODY AT ANGLE OF ATTACK

Ihor O. Bohachevsky and Robert E. Mates Washington, NASA, May 1966 42 p refs

(Contract NAS5-3976)

(NASA-CR-483) CFSTI: HC $2.00/MF $0.50 CSCL 01A

This report presents a solution for the supersonic inviscid flow around a spherically blunted body with a conically reentrant afterbody flying at a large angle of attack. The investigation was carried out by means of a direct numerical method for the calculation of unsteady, three-dimensional flow fields containing strong shock waves. The results presented include the location and shape of the bow shock and sonic lines, streamline patterns, the location of the stagnation point, and typical fluid property variations. The structure of the flow field is shown to be strongly influenced by the large angle of attack and by the body shape. The solution obtained is for an ideal gas; however, the method was developed in such a way that it can be readily extended to include nonequilibrium real gas effects. A description of the method and of special computational techniques required for its application is included. Author

N66-25256# Lockheed Missiles and Space Co., Sunnyvale, Calif.

SUPERSONIC AIR FLOW AROUND A SPHERE TAKING ACCOUNT OF EQUILIBRIUM RADIATION

V. K. Vertushkin [1966] 7 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 4, no. 1, 1966 p 162–164

Consideration is given to radiation which exerts an essential influence on the distribution of the gasdynamic parameters behind the shock when a body reenters the dense layers of the atmosphere at supersonic speeds. The limiting case of an equilibrium radiating gas which neglects absorption of the radiation is examined. Included are results of an analysis of the air flow around a sphere with a radius of 100 cm, and traveling at a velocity of 11.4 km/sec at 60 km altitude. C.T.C.

N66-25268# Sylvania Electric Products, Inc., Needham, Mass. Sylvania Electronic Systems–East.

OPTIMIZATION OF AERODYNAMIC EQUATIONS

Henry J. Wychorski Port Washington, N. Y., Naval Training Device Center, Feb. 1966 140 p

(Contract N61339-1495)

(NAVTRADEVCEN-1495-1; AD-630268) CFSTI: HC $12.60/MF $1.00

An evaluation study was conducted on UDOFTT (Universal Digital Flight Trainer Tool) during which a set of complete aerodynamic equations pertaining to a supersonic swept wing high performance aircraft was simulated and then optimized. The influence of expanding the integration interval on the flying qualities was also investigated. The study indicated that 12 terms could be eliminated from the flight equations and that the quadrature interval for O33 Mod Gurk could be expanded without adverse influence on the flying qualities of the trainer. One area that was investigated and

found to contribute significant influence on both performance and flying qualities was c.g. position variation. Testing was limited to the clean airplane. Some of the terms included in this investigation take on added significance in unusual flight or other conditions and it is suggested that additional analysis be performed where this exists. Author (TAB)

N66-25286# Lockheed Missiles and Space Co., Sunnyvale, Calif.
AERODYNAMIC CHARACTERISTICS OF RECTANGULAR PLATES IN HYPERSONIC RAREFIED GAS FLOW
M. D. Ladyzhenskii and A. V. Lipin [1966] 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidk. I Gaza (Moscow), no. 1, 1966 p 142–144

In order to determine the optimum wing shapes in a viscous hypersonic flow, experimental investigations of the aerodynamic characteristics of rectangular plates of the same area, but of different span and thickness, were conducted at an unperturbed Mach number of 5.15, Reynolds number of 2×10^2, and angles of attack varying from 0° to 40°. The span of the plates changed within the 0.1 to 9 ranges, and their relative thickness within the 0.024 and 0.16 range. It was established that for fixed values of the area and thickness of rectangular plates, the dependence of its maximum aerodynamic quality $K_m(\lambda)$ has a maximum in the $\lambda=0.4$ to 0.8 range in the investigated angle of attack range. Author

N66-25322# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Porz (West Germany).
DVL-NEWS, NO. 29/30 [DVL-NACHRICHTEN, HEFT 29/30]
H. Ebner et al Jan. 1966 49 p refs In GERMAN
CFSTI: HC $2.00/MF $0.50

Presented are brief design and development outlines of the various research sections working in the German Experimental Institute for Air and Space Travel. Work at the laboratory for air communications and microwave centered on the design of a transportable radar apparatus with automatic tracing display, and the development of a very high antenna; the laboratory for guidance and control technique worked on timing theories, sensor and calculation techniques, and on flying systems for the development of a satellite motion simulator; and the flight mechanics laboratory reported performance measurements on modern aircraft. Annotated abstracts of DVL publications number 423 to 504 are included. Transl. by G.G.

N66-25324# Federal Aviation Agency, Washington, D. C. Approach and Landing Branch.
TRAILING CONE TESTS IN LARGE TURBOJET
William M. Russell Mar. 1966 32 p refs
(RD-66-15)

The report explains FAA tests in a large turbojet airplane of the trailing cone technique for measuring static source error. During the test series a total of nineteen flights were flown investigating the physical and operational parameters affecting trailing cone system performance. Several items pertinent to conducting trailing cone calibrations are also discussed. Recommendations are stated regarding application of the technique to airworthiness determination and establishing eligibility for 1000 foot vertical separation. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N66-24384*# Schjeldahl (G. T.) Co., Northfield, Minn. Advanced Programs Div.
INVESTIGATION OF THE FLIGHT CHARACTERISTICS OF FREE FLYING AERODYNAMICALLY SHAPED BALLOONS Final Report
Clinton V. Eckstrom [1965] 49 p refs
(Contract NAS1-5271)
(NASA-CR-66093) CFSTI: HC $2.00/MF $0.50 CSCL 01C

The investigation of the flight characteristics of free-flying aerodynamically shaped balloons included a literature study, an aerodynamic analysis, and fabrication and flight test of six streamlined balloons. A small streamlined balloon design was achieved which resulted in stable, nose-up flight from ground launch to float altitude. All the large streamlined balloons of 150 cubic foot volume failed to fly at zero angle of attack but rather were stable at near horizontal position during the visible portion of the flight. Variations in flight stability did occur at higher altitudes as determined from radar plot board data and as predicted by the force equilibrium equations presented. Author

N66-24408# Royal Netherlands Aircraft Factories Fokker, Amsterdam.
DYNAMIC BEHAVIOUR OF AIRCRAFT SEATS
30 Mar. 1965 18 p
(FS-13) CFSTI: HC $1.00/MF $0.50

The occupant tie-down systems behavior during aircraft deceleration was studied using simple mass spring systems. The calculation method and results are presented. Load-elongation curves were chosen for seat and belt together. The characteristics for the recorded calculations were selected to represent a tie-down system under longitudinal deceleration. Results show that clearance and prestretch in the tie-down system have an unfavorable influence on failure resistance. Extra plastic deformation was considered an improvement. But it was further found that in cases where the maximum deceleration exceeds the static strength during anything but a very short period of time, failure will occur in any case. N.E.N.

N66-24464# Columbia Univ., Dobbs Ferry, N. Y. Hudson Labs
THE SEARCH UNDERWATER FOR A DOWNED NAVY JET AIRCRAFT Technical Report No. 122
J. Brakl, J. Shaffer, and G. H. Fisher 6 Dec. 1965 28 p ref
(Contract Nonr-266(84))
(CU-146-65-ONR-266-Phys.; AD-628781) CFSTI: HC $2.60/MF $0.50

A search was undertaken during May 1965 for a U.S. Navy jet aircraft that went down in the Buzzards Bay area on April 29, 1965. The operational procedure of the search, as well as the capabilities of the three instruments that were used in it—sidelooker, magnetometer, underwater TV—are

described. Several anomalous situations are shown and discussed, and recommendations are made for future searches of a similar nature. Author (TAB)

N66-24560# Royal Netherlands Aircraft Factories Fokker, Amsterdam.
THE FOKKER F-28 FELLOWSHIP Technical Paper No. 512
J. H. Greidanus [1965] 25 p Presented at the 24th Ann. Conf. of SAWE, Denver, May 1965
CFSTI: HC $1.00/MF $0.50

This report describes the structural features and flight characteristics of the Fokker F-28 Fellowship aircraft. The F-28 is a small twin turbofan aircraft adapted to the requirements of short-haul, local, passenger transportation. Its general configuration and size were determined in a long and tedious process of analyzing economy, weights and performance, market prospects, and airline requirements. The F-28 uses two Rolls-Royce Spey Jr. engines in an aft-engined configuration like the Caravelle. The aircraft has high performance in takeoff and landing, with a runway requirement of from 5000 to 6000 ft; very good stability, maneuverability, and control in takeoff, approach, and landing conditions; low pressure tires to permit operations from less sophisticated runways; a high structural fatigue resistance to cope with the load cycle of frequent takeoffs and landings, and of flights at low altitude; and self-support and quick turn-around capabilities. Also included are discussions of the aircraft's wing design, payload range, T-tail configuration, adjustable drag feature, braking methods, control system, structure, and loading. R.N.A.

N66-24606*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CONFERENCE ON V/STOL AND STOL AIRCRAFT
Washington, NASA, 1966 461 p refs Conf. held 4–5 Apr. 1966
(NASA-SP-116) CFSTI: HC $5.25/MF $2.25 CSCL 01C

Conference papers on aerodynamics and propulsion, handling qualities, feasibility studies, and research testing techniques for STOL and V/STOL aircraft are presented. For individual titles see N66-24607–N66-24633.

N66-24607*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HANDLING QUALITIES AND STRUCTURAL CHARACTERISTICS OF THE HINGELESS-ROTOR HELICOPTER
Robert J. Huston and John F. Ward *In* NASA. Ames Res. Center Conf. on V/STOL and STOL Aircraft 1966 p 1–16 refs (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

Several advantages and potential problem areas associated with the hingeless-rotor helicopter are discussed. The extent to which two of the advantages—increased control and damping moments—can be obtained with the hingeless-rotor helicopter was established. The upper limit on the available control and damping moments is associated with the excessive gyroscopic coupling that is obtained with heavy rotor blades. The potential problem areas identified include a structural mode of oscillation very similar to that of a pendulum, which causes undesirably large roll accelerations under certain flight conditions, and large cyclic chordwise bending moments that occur during severe maneuvers (the primary structural problem of concern). Solutions are proposed which should eliminate future concern with these problems. Author

N66-24611*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPARISON OF WIND-TUNNEL AND FLIGHT RESULTS ON A FOUR-PROPELLER TILT-WING CONFIGURATION
Kenneth W. Goodson *In* NASA. Ames Res. Center Conf. on V/STOL and STOL Aircraft 1966 p 51–62 refs (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

Extensive tests were made on several sizes of wind-tunnel models of the XC-142A V/STOL configuration and on the airplane. These results show that models predict the slow-speed level-flight characteristics very well but that small models underpredict the descent capability of the airplane. Larger scale wind-tunnel models of approximately half size show better agreement with the airplane descent characteristics. It was found from smoke flow studies that small models can also predict the region in which self-generated disturbances will be encountered by tilt-wing configurations in ground proximity. Author

N66-24613*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AERODYNAMIC CHARACTERISTICS OF A V/STOL TRANSPORT MODEL WITH LIFT AND LIFT-CRUISE FAN POWER PLANTS
David H. Hickey, Jerry V. Kirk, and Leo P. Hall *In its* Conf. on V/STOL and STOL Aircraft 1966 p 81–96 refs (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

The aerodynamic characteristics of lift fans mounted ahead of the wing, rotating cruise fans, and tandem mounted lift fans faired into the wing were studied. The tests results indicated that the complete configurations, that is, the lift-cruise fan and tandem lift fan configurations, had generally acceptable aerodynamic characteristics. The positive induced lift due to fan flow interference with the airplane flow field was a small percentage of the installed thrust but was adequate to provide significant increases in payload with STOL operation. Author

N66-24615*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AERODYNAMIC STABILITY AND CONTROL OF DUCTED-PROPELLER AIRCRAFT
Ralph L. Maki and Demo J. Giulianetti *In its* Conf. on V/STOL and STOL Aircraft 1966 p 115–128 (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

Test results from studies of small and large powered models of a dual, tandem, ducted-propeller VTOL design are reviewed, with emphasis on stability and control characteristics through the transition speed range. The characteristics are generally satisfactory. Stability augmentation may be required to reduce Dutch roll tendencies. Further study is needed to evaluate the apparently large side-force gradients in sideslip. Reductions in control effectiveness due to ground proximity are similar to those for tilt-wing V/STOL designs. Author

N66-24616*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN APPROACH TO EFFICIENT LOW-SPEED FLIGHT FOR FAN-POWERED V/STOL AIRCRAFT
Marion O. Mc Kinney, Lysle P. Parlett, and William A. Newsom, Jr. *In* NASA. Ames Res. Center Conf. on V/STOL and STOL Aircraft 1966 p 129–137 (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

Exploratory tests were performed on a fan-powered V/STOL configuration which reduces the thrust required in transition flight to the desirably low values heretofore as-

sociated almost exclusively with tilt-wing and deflected-slipstream propeller-driven V/STOL configurations. The configuration employs cruise fans spaced out along the leading edge of a fixed wing having a large double-slotted trailing-edge flap. The fan exhaust is directed partly above and partly below the wing. That part of the fan exhaust which passes below the wing spreads out, blows virtually the entire flap system, and induces a circulation which efficiently produces large lift forces at low forward speeds. Author

N66-24617*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

CRUISE PERFORMANCE AND STABILITY CONSIDERATIONS FOR JET V/STOL AIRCRAFT

William J. Alford, Jr. and Roy V. Harris, Jr. *In* NASA. Ames Res. Center Conf. on V/STOL and STOL Aircraft 1966 p 139–161 refs (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

A study was made of some of the conditions necessary to provide good cruise performance and stability characteristics for jet V/STOL aircraft with consideration of multimission aspects. The study indicates that refinements in subsonic aerodynamic efficiency can be obtained by increases in wing span, reductions in wetted area, and improvements in airplane cleanliness. Refinements in supersonic efficiency can be obtained by increases in equivalent-body fineness ratio. Configurations utilizing composite-wing planforms with large fixed forewings are likely to have adverse wing-body pitching-moment characteristics and will require careful choice of vertical location of the horizontal tail to avoid pitch-up. Because of interactions of the lifting-jet system with the wing and horizontal tail, conflicts may exist between the cruise and V/STOL requirements for the composite-wing configurations. For variable-sweep configurations an additional aerodynamic-center variation is associated with wing sweep. There are several schemes for minimizing this variation and also for controlling the aerodynamic-center shift. Author

N66-24618*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

THRUST LOSSES IN HOVERING FOR JET VTOL AIRCRAFT

Alexander D. Hammond *In* NASA. Ames Res. Center Conf. on V/STOL and STOL Aircraft 1966 p 163–176 refs (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

This paper is primarily concerned with two items: (1) the jet-induced base loss encountered during hovering flight; and (2) the effect of ground proximity on this loss. The jet-induced base loss was found to be a function of the total planform area of the configuration and the rate of mixing of the exhaust gases and the surrounding air. Although from the standpoint of noise and ground erosion a rapid rate of mixing is desirable, the base loss becomes larger as the mixing rate increases. The hovering ground effects for single-jet configurations can be satisfactorily predicted from available data. For multijet configurations the ground effects depend on the configurational arrangement and, although considerable data are available, tests on the particular multijet arrangement may be necessary. Author

N66-24619*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

JET-INDUCED EFFECTS IN TRANSITION FLIGHT

Richard J. Margason *In* NASA. Ames Res. Center Conf. on V/STOL and STOL Aircraft 1966 p 177–189 refs (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

Some of the characteristics of jet-powered VTOL fighter airplanes in transition from jet-supported hover to wing-supported forward flight are presented. Wind-tunnel investigations have shown that interference between the jet wakes and the free stream causes significant increments of nose-up pitching moment and lift loss. Some methods of reducing these interference increments by configuration variations, such as changes in the wing planform and jet arrangement, are presented. The effects of the jet on the tail contribution to stability are also shown to be largely configuration dependent. The evidence indicates that configurations can be devised which have very little effect of power on longitudinal stability. Jet-induced rolling moments in sideslip may be a serious problem, and at present there appears to be little hope of completely eliminating this problem. Therefore, it is necessary to design the controls to handle these jet-induced rolling moments. Author

N66-24620*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

CONSIDERATIONS OF HOT-GAS INGESTION FOR JET V/STOL AIRCRAFT

H. Clyde Mc Lemore *In* NASA. Ames Res. Center Conf. on V/STOL and STOL Aircraft 1966 p 191–204 refs (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

Hot-gas ingestion tests have been conducted out of doors on a relatively large-scale fighter-type VTOL model. The model had a J85 turbojet engine mounted in the fuselage, which could be fitted with various inlet and exhaust arrangements. Results of tests of this model and other research vehicles and models have shown that aircraft configuration—particularly the exhaust and inlet arrangement—and surface winds can greatly alter the hot-gas ingestion problem. Deflecting the engine exhaust gases rearward and making rolling take-offs to stay ahead of the hot-gas field appears to be one solution to the hot-gas ingestion problem. Another solution is to design the aircraft so that components such as wings shield the engine inlets from the direct path of the hot exhaust gases and so that the fountain effect caused by multiple-exhaust-nozzle configurations is minimized. Author

N66-24622*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

CONSIDERATIONS FOR REVISION OF V/STOL HANDLING QUALITIES CRITERIA

Seth B. Anderson *In its* Conf. on V/STOL and STOL Aircraft 1966 p 229–247 refs (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

A review of selected V/STOL handling qualities was made to provide information to be used to update and revise V/STOL handling qualities requirements. Comparisons are made of recent flight and simulator results with existing V/STOL requirements. The results show that improved guidelines are becoming available to aid the designer of V/STOL aircraft. Author

N66-24623*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SIMULATOR INVESTIGATIONS OF VARIOUS CONTROL SYSTEMS FOR VTOL AIRCRAFT

Richard K. Greif, Emmett B. Fry, Terrence D. Gossett, and Ronald M. Gerdes *In its* Conf. on V/STOL and STOL Aircraft 1966 p 249–267 refs (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

A six-degree-of-freedom motion simulator was used to investigate control system requirements for VTOL aircraft; emphasis was placed on the hovering task together with the small maneuvers associated with hover. The primary objectives were the improvement of handling qualities with a reduction in control power requirements. The variables of three control systems, i.e., an acceleration system, a rate system, and an attitude system, were optimized; and the results are compared. Also, the characteristics and suitability of the simulator are discussed in detail. D.T.

N66-24624*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

FLIGHT STUDY OF ON-OFF CONTROL FOR V/STOL AIRCRAFT

John F. Garren, Jr. and James R. Kelly *In* NASA. Ames Res. Center Conf. on V/STOL and STOL Aircraft 1966 p 269-279 refs (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

Because of the severe performance penalties associated with providing high levels of control power in V/STOL aircraft, methods which offer a potential for reducing control power requirements warrant consideration. One such method is the on-off type of control. The lateral results of a visual flight investigation utilizing on on-off pitch and roll control in a variable-stability helicopter are presented. The size of the control dead band was found to be a critical parameter in providing acceptable handling characteristics. The significant reduction in control power requirements realized by using the on-off control is illustrated by a comparison with the results of a similar investigation using a proportional control system. The effects of angular-velocity damping, trim requirements, and disturbances are discussed. Author

N66-24625*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

RESULTS OF A BRIEF FLIGHT INVESTIGATION OF A COIN-TYPE STOL AIRCRAFT

Terrell W. Feistel, Curt A. Holzhauser, and Robert C. Innis *In its* Conf. on V/STOL and STOL Aircraft 1966 p 281-294 refs (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

It is shown that a current generation COIN aircraft is capable of good low-speed performance and handling qualities when flown in the STOL regime, provided the possibility of engine failure is ignored or a suitable safeguard, such as cross shafting, is incorporated. This performance is achieved in spite of the flaps having only medium effectiveness because the aircraft has a low aspect ratio, a high power loading, and a landing gear designed for no-flare landings. However, when it is flown above the minimum single engine control speed, in compliance with the safety restrictions for twin-engine airplanes, major aspects of the performance are no better than that obtainable with many small twin engine aircraft in current production, and most of the original objectives of the COIN concept are compromised. Author

N66-24626*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

LATERAL-DIRECTIONAL AUGMENTATION CRITERIA FOR JET SWEPT-WING TRANSPORT AIRPLANES OPERATING AT STOL AIRSPEEDS

Hervey C. Quigley, Richard F. Vomaske, and Robert C. Innis *In its* Conf. on V/STOL and STOL Aircraft 1966 p 295-310 refs (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

A flight and simulator study of the lateral-directional characteristics of a typical swept-wing jet transport operating at landing approach speeds between 80 and 90 knots has shown the need for augmentation to achieve satisfactory handling qualities. Primary considerations must be given to the yaw axis, to increasing the Dutch-roll damping, and to improving turn coordination. Lateral axis augmentation to reduce the dihedral effect, to increase the roll damping, and to stabilize the spiral mode must also be considered. The control authority required in the augmentation system will depend on the maneuvering required in the landing approach. Flight tests have demonstrated that with proper augmentation, satisfactory handling qualities are possible at a landing approach speed as low as 80 knots. Author

N66-24627*# Boeing Co., Seattle, Wash.

REVIEW AND EVALUATION OF BOEING DESIGNS FOR THE NASA SHORT-HAUL COMMERCIAL TRANSPORT STUDY

Bernard L. Fry *In* NASA. Ames Res. Center Conf. on V/STOL and STOL Aircraft 1966 p 315-338 refs (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

Concepts and typical design tradeoffs are considered for a number of V/STOL aircraft configurations. These include: tilt wing, jet lift, stowed rotor, and lift fan VTOL models; and fan-in-wing and turbofan STOL models. The propulsion and control systems are described for each type of craft, along the relative performance and aerodynamic characteristics and handling qualities. Acquisition and direct operating costs were calculated; and the public acceptance of these craft is discussed in terms of noise, ride qualities, and passenger appeal. It was concluded that the most promising craft for commercial applications are the turbofan STOL and tilt wing VTOL. D.T.

N66-24628*# Boeing Co., Seattle, Wash.

A REVIEW OF STOL DESIGNS FOR THE NASA SHORT-HAUL TRANSPORT STUDY

Joseph M. Zabinsky *In* NASA. Ames Res. Center Conf. on V/STOL and STOL Aircraft 1966 p 339-351 refs (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

A number of V/STOL aircraft designs were evaluated for use in commercial transport applications. These include: tilt wing, jet lift, lift fan, and stowed rotor VTOL designs; and fan-in-wing and externally blown flap turbofan STOL designs. The aircraft were designed for minimum direct operating cost at a maximum stage length of 500 statute miles with a payload of 60 passengers and 1200 pounds of revenue cargo. Two integral airstairs were assumed in each aircraft and auxiliary power unit was stipulated. D.T.

N66-24629*# Ling-Temco-Vought, Inc., Dallas, Tex.

SUMMARY OF LING-TEMCO-VOUGHT FEASIBILITY STUDIES

Keith R. Marsh, Jesse J. Santamaria, and Robert B. English *In* NASA. Ames Res. Center Conf. on V/STOL and STOL Aircraft 1966 p 353-388 refs (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

Ten and eighteen point design feasibility studies were performed on the turboprop, fan-in-wing, and propulsive wing V/STOL concepts for short haul commercial passenger transport applications. The turboprop and fan-in-wing concepts were considered for VTOL, STOL, and V/STOL configurations; the propulsive wing concept was considered only for the STOL configuration. All point designs were optimized to give a minimum direct operating cost on a 500 mile stage length; and 60, 90, and 120 passenger craft are discussed. D.T.

N66-24630*# Lockheed Aircraft Corp., Burbank, Calif.
NASA-LOCKHEED SHORT-HAUL TRANSPORT STUDY
Richard Scherrer, W. C. J. Garrard, Edward M. Davis, and Wm. D. Morrison *In* NASA. Ames Res. Center Conf. on V/STOL and STOL Aircraft 1966 p 389-407 refs (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

An integrated concept development and vehicle optimization study was performed for several V/STOL configurations. These included: the turbofan jet-flap, fan-in-wing, and deflected slipstream STOL designs; and the lift/cruise fan, tilt-wing turboprop, and stopped rotor VTOL designs. The most promising craft were concluded to be the jet-flap for STOL designs, and the tilt-wing for VTOL designs. It was also concluded that noise is the major problem to be overcome in order to achieve public acceptance of these craft. D.T.

N66-24850# Air Force Logistics Command, Wright-Patterson AFB, Ohio. Operations Analysis Office.
MAXIMUM TIME POLICIES
John L. Madden Jan. 1966 19 p refs Presented at the 12th Ann. Symp. on Reliability, San Francisco, 25-27 Jan. 1966 *Its* Operations Analysis Rept. No.-6
(AD-477704)

A cost-effective mathematical model to determine optimal (least long run cost) maximum allowable operating times for aircraft engines is described. The model uses actuarial failure rates to forecast future engine repairs under different maximum time policies and then determines the costs for each policy by using average costs per engine repair. All significant logistics costs associated with each repair action are included, such as estimates of average removal and reinstallation costs, costs of transporting engines to and from the repair facility, and repair costs. Costs are also used for the extra spare engines required to support given maximum time policies, for the penalty associated with aircraft downtime, and for the risks associated with unscheduled engine failures.
Author (TAB)

N66-24861# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Life Sciences Section.
A SIMULATOR STUDY OF LOW SPEED VTOL HANDLING QUALITIES IN TURBULENCE Final Report
Harry T. Bruel Feb. 1966 94 p refs
(Contract NOw-63-0518-c)
(RE-238; AD-477949)

An experimental study was performed to determine, from the pilot's point of view, the effects of certain stability derivatives, atmospheric turbulence, and control power on the handling qualities of VTOL craft. Using a flight simulator, qualified pilots evaluated over 450 configurations in the task of moving the craft from one hover spot to another. The simulator consisted of a cockpit providing motion in roll and pitch and an optical display system providing an illusion of motion in the remaining four degrees of freedom. The primary conclusion drawn from the study is that speed stability, either lateral or longitudinal, strongly influences a hovering vehicle's control power and angular rate damping requirements. Furthermore, lateral and longitudinal requirements are found to be similar, when the effects of speed stability are taken into account.
Author (TAB)

N66-24904# Technisch Documentatie en Informatie Centrum Voor de Krijgsmacht, The Hague (Netherlands).
SURVEY OF LITERATURE ON AVIATION TECHNOLOGY [LITERATUUROVERZICHT LUCHTVAARTTECHNIEK]
26 Feb. 1966 24 p refs In ENGLISH, GERMAN, and DUTCH *Its* Vol. 14, No. L-292
CFSTI: HC $1.00/MF $0.50

Abstracts are presented of reports on helicopter design, research, and development in the areas of fuels, rotors, and turbofans; stability and control; air traffic control, navigational systems and equipment; escape parachutes and rocket catapults; and aerodynamics.
N.E.N.

N66-25173# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).
METHODS FOR THE MEASUREMENT OF THE POLAR DIAGRAM OF THE IRRADIATION INTENSITY FROM AIRPLANES [MESSMETHODEN ZUR MESSUNG DER INFRAROT-STRAHLUNGSCHARAKTERISTIKEN VON FLUGZEUGEN]
Friedrich Katheder and Gerhard Miosga Feb. 1965 43 p refs In GERMAN; ENGLISH summary
(DLR-FB-65-11) CFSTI: HC $2.00/MF $0.50

The paper describes the measurement of the IR-radiation energy of the jet G91 (R3) during its flight with a Barnes R-4K1 space-filtering-radiometer in the spectral region 1.6 μ to 2.6 μ. The measuring equipment, data-recording and data-reduction are described. The measurements only have been taken at night due to the high radiation level from background during day time. The result, the IR-radiation-characteristic, shows that the emitted IR-radiation depends very much on the aspect angle to the plane (angle between the plane-axis and the line of sight).
Author

N66-25180# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
METHOD FOR THE DETERMINATION OF THE NOISE FROM TURBOJET AIRCRAFT ON TAKEOFF TRAJECTORIES [METHODE DE CALCUL DU BRUIT PRODUIT PAR DES AVIONS A REACTION SUR LEUR TRAJECTOIRE DE DECOLLAGE]
Michel Kobrynski 1965 71 p refs In FRENCH; ENGLISH summary
(ONERA-TN-81(1965))

The approximate determination of the maximum sound pressure of turbojet aircraft on the ground or in subsonic flight may be carried out from the laws of jet noise emissions by means of the generalized spectrum of the sound pressure and of the directivity of the acoustic rays. A first method applicable when the jet Mach number is smaller than 2 (with respect to the velocity of sound in the atmosphere) takes into account the theoretical variation of the acoustic power proportional to V_j with V_j as the jet velocity. If the jet is in motion, the basic parameter is the difference $V_j - V_a$ in which V_a represents the aircraft velocity. In the second method the eddy convection Mach number M_c and also, when necessary, the aircraft Mach number M, are taken into account in the form of a correction factor

$$\left[1-(M_c-M/2)\cos\theta_M\right]^{-\eta}(1+M\cos\theta_M)^{-5},$$

with exponent η and the emission angle θ_M of the maximum acoustic radiation being both functions of M_c. This method is applicable for the pre-determination of the noise of future airplanes such as Concorde, the jet Mach number of which, relative to the atmospheric speed of sound, would be in the order of 2.5.
Author

N66-25201# Royal Aircraft Establishment, Bedford (England).
THE DEVELOPMENT OF AN ARTIFICIAL STALL WARNING SYSTEM FOR A DELTA WING AIRCRAFT (JAVELIN MK. I)
D. R. Andrews, M. Coxon, and R. Rose London, Min. of Supply, Dec. 1956 46 p refs
(RAE-AERO-2579) (Declassified)

The unsatisfactory stalling behavior of the Javelin Mk.1 aircraft has led to the requirement for an artificial stall warning system to augment the natural stall warning at all Mach numbers. This report describes the tests carried out to develop the aerodynamics of such a system. It was found that, by locating stall detector vanes at certain positions on the wing, a two stage artificial stall warning could be produced to give an initial warning soon after the onset of buffet and a final warning along the boundary for zero stick force per g at all Mach numbers up to about 0.9. A contacting A.S.I. was used in addition to bring in the initial warning at all speeds below 160 knots regardless of normal acceleration. For pilot assessment purposes, this stall detector system was used in conjunction with an audio form of presentation, although further development work is required to make an acceptable presentation of this type. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N66-24011# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL RESEARCH ON INFLUENCE OF PARTIALITY AND HEIGHT OF BLADES ON OPERATION OF THE AIR CENTRIPETAL MICRO-TURBINE
N. T. Tikhonov *In its* News of Inst. of Higher Learning 6 Jan. 1966 p 192-207 ref (See N66-23994 13-01) CFSTI: HC $26.30/MF $1.25

Experimental data are given which were obtained during research on single-stage velocity centripetal air micro-turbines. The basic dimensions of a turbine of this type are given and the operating clearances and mutual location of the nozzle and the impeller are shown. It is pointed out that an important peculiarity of micro-turbines is reduced peripheral velocity, and that limited rpm is the basic cause. Additionally, the degree of partiality with a given flow rate of air can be increased by decreasing the height of the nozzle ducts; this decrease, however, changes the efficiency of the turbine. Techniques for optimizing this condition are discussed and conclusions are drawn from this investigation which may be used as guidelines for designing micro-turbines for industrial applications. H.S.W.

N66-24098# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF STORING ELECTRICAL ENERGY
N. Ye. Zayev 5 Nov. 1965 8 p Transl. into ENGLISH from Russian patent no. 153985 (Appl. no. 740615/26-10, 31 Jul. 1961) 3 p
(FTD-TT-64-485/1+2+4; AD-628299) CFSTI: HC $1.10/MF $0.50

The proposed method is attained by the use as storing material a solid dielectric with predominately electron conductivity. The dielectric undergoes a long charging at high temperature (relative to the operating temperature on discharging) by a high voltage close to the disruptive. From contact metallized surfaces a high voltage of dc microcurrent is obtained. TAB

N66-24110*# Vickers, Inc., Torrance, Calif. Aerospace Div.
DEVELOPMENT OF AUXILIARY ELECTRIC POWER SUPPLY SYSTEM Monthly Progress Report, Oct. 1962
R. C. Thomas [1962] 62 p
(Contract NAS3-2550)
(NASA-CR-71793; PR-91565-430-4) CFSTI: HC $3.00/MF $0.75 CSCL 10B

An engineering study of an electrical power generation system operating on hydrogen and oxygen in a space environment was conducted. The program plan schedule is given. System components were designed and tested. Emphasis in this period was placed on the propellant feed control system. Discussed are the closed loop compressor; the hydrogen-oxygen heat exchanger; the regenerator; and the pressure regulator. A schematic block diagram of the overall control system is given. Design configurations for the exhaust-hydrogen regenerator, the hydrogen-oxygen heat exchanger, and regenerator components, are depicted. L.S.

N66-24382*# General Electric Co., Gainesville, Fla. Battery Business Section.
DEVELOPMENT OF IMPROVED CADMIUM ELECTRODES FOR SEALED SECONDARY BATTERIES Interim Report No. 1
H. H. Kroger 30 Mar. 1966 92 p
(Contract NAS3-7636)
(NASA-CR-54937) CFSTI: HC $3.00/MF $0.75 CSCL 10C

Physical properties, impregnability, and electrochemical behavior of experimental nickel fiber plaques were compared to those of currently available nickel powder sinter plaques. Contrary to expectations, the new plaques did not prove to be a better material for the negative electrode of the nickel-cadmium couple than the controls. The unfavorable pore size distribution of the fiber plaques was the reason for excessive losses of active material during capacity testing and led to numerous short circuits inside the cells. Author

N66-24496*# Clevite Corp., Cleveland, Ohio. Electronic Research Div.
STUDY OF THIN FILM LARGE AREA PHOTOVOLTAIC SOLAR ENERGY CONVERTER First Quarterly Report, 25 Oct. 1965-24 Jan. 1966
F. A. Shirland, J. R. Hietanen, F. Augustine, and W. K. Bower 28 Feb. 1966 23 p ref
(Contract NAS3-8502)
(NASA-CR-74581) CFSTI: HC $1.00/MF $0.50 CSCL 10A

Progress is reported in the development of a cadmium sulfide thin film photovoltaic cell for use in a solar energy converter. Study of the transient degradation effect following cell heating indicates this effect to be characteristic of copper and silver contacts to the barrier, but not of gold contacts. The effect, which is associated with the contact and not the bulk material, appears to have been the cause of failure on temperature cycling test of the cells with grids cemented down with conductive silver epoxy. Tests indicate that cells with gold-plated copper grids cemented down with gold-filled epoxy should be immune to the transient degradation effect. Stability studies are reported on shelf storage and effects of process

changes, as well as for temperature cycling and effect of epoxy lamination adhesive. Attention is also given to cell design, standard process line for fabrication, and direction of future research. M.W.R.

N66-24536*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A COMPARISON OF SOLAR CELL DAMAGE BY ALPHA PARTICLES AND PROTONS
Albert B. Smith and James W. Blue Washington, NASA, May 1966 15 p refs
(NASA-TN-D-3427) CFSTI: HC $1.00/MF $0.50 CSCL 10A

The short circuit current of silicon solar cells illuminated with 2800°K light was measured after the cells received successive increments of proton or alpha particle bombardment. The incident particle energies were 10.5 and 42 MeV respectively, and therefore have identical velocity distributions and ranges in the solar cell. The ratio of the proton flux to the alpha particle flux to produce the same degradation in short circuit current is 3.8. For particles of equal velocity, the ratio of the Coulomb cross section for alpha particles to that of protons to produce silicon recoils of equal energy is 4. If the experimental uncertainties are considered, the experimental result is in agreement with this ratio, and this agreement implies that the relatively few high energy recoils from close alpha particle collisions do not contribute significantly to the cell degradation. Author

N66-24598*# Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
INVESTIGATION OF THIN DIELECTRIC FILMS FOR ENERGY CONVERSION Final Report
26 Jul. 1965 120 p refs
(Contract NAS2-1995)
(NASA-CR-71744; AAD-51255) CFSTI: HC $4.00/MF $0.75 CSCL 10A

This report describes experimental and analytical investigations of the thermoelectrostatic solar energy conversion cycle. Explicit consideration of the effects of withdrawal of electrical energy during energy conversion show that for appreciable conversion efficiency, the dielectric must be able to support an electrical field of sufficiently large value as expressed in material parameters, but that beyond a specific value, there is little value in greater dielectric strength. This development shows that plastic films are significantly superior to ferroelectrics when power per unit weight is computed. Various thermodynamic and switching cycles are analyzed in order to identify the most desirable process design for energy conversion. It is shown that loss factor in a plastic film instead of being disadvantageous is a favorable parameter in thermoelectrostatic energy conversion. During the exploratory half of the experimental work, a wide variety of plastic materials and some ferroelectrics were examined. In experiments performed in a space environmental chamber at temperatures down to −130°C, and pressures of 10^{-6} torr, unambiguous energy conversion was demonstrated with mylar–lexan composite films, without the necessity of correcting for internal leakage. Author

N66-24641*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TWO LEVEL VOLTAGE LIMITER
N. Potter and R. Morrison Jan. 1966 22 p
(NASA-TM-X-55446; X-716-66-7) CFSTI: HC $1.00/MF $0.50 CSCL 10B

The circuitry is described for a two level voltage limiter, which consists of a differential amplifier, two amplifier stages, and a dumping circuit. The device is to be used to control the charge current to a silver cadmium battery, in order to prevent an overcharge and the consequent pressure rise. The limiter specifications are given for two ranges of operation; and the calibration procedures are described in detail. D.T.

N66-24650# General Electric Co., Philadelphia, Pa.
AN ELECTRICAL POWER SUPPLY FOR A HIGHLY ELLIPTICAL ORBITING SATELLITE AND GGTS SPECIFICATION FOR GGTS BLUE FILTER WINDOWS FOR SOLAR CELLS
J. K. Baker, A. S. Kirpich, and I. M. Sachs 20 Aug. 1965 108 p refs
(Rept.-65SD312)

A power supply is described for a small spin-stabilized spacecraft in a highly elliptical orbit (190 km × 320,000 km). The power supply derives its primary power from solar photovoltaic array, and utilizes a silver–cadmium battery for power during the eclipses. Power conditioning equipment is also described. Author

N66-24698*# General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.
TWO STAGE POTASSIUM TEST TURBINE Quarterly Progress Report No. 18, 8 Aug.–8 Nov. 1965
E. Schnetzer, ed. 10 Jan. 1966 301 p refs
(Contract NAS5-1143)
(NASA-CR-54917) CFSTI: HC $7.00/MF $1.75 CSCL 10A

The assembly, testing, and evaluation of the turbine and associated components are reported. The reassembly of the turbine following performance testing was finished, and endurance testing at 1500°F was completed. No substantial change in the turbine operation was noticed at the end of the test. Tabulated and plot performance data are presented for the first 1000 hours of testing. The water and oxygen content of the argon supplied to the turbine, the boiler flue gas, and the oxygen and elemental carbon content of the flowing potassium were monitored during the endurance testing. All contamination quantities were found to be low. After 254 hours of testing, niobium alloys were found to be contaminated by carbon, but the molybdenum alloys were relatively free of contamination. A uniform metal deposit on both rotor stages was reported. N.E.N.

N66-24792# Massachusetts Inst. of Tech., Cambridge. Engineering Projects Lab.
BASIC APPLIED RESEARCH IN FLUID POWER CONTROL
S.-Y. Lee and H. H. Richardson May 1965 130 p refs
(Contract AF 33(615)-2210)
(AFFDL-TR-65-79; AD-624885) CFSTI: HC $4.00/MF $1.00

The report presents technical results and describes progress in several phases of continuing applied research and development related to the design and development of high-performance fluid control devices for advanced aerospace systems. Emphasis continues to be placed on pneumatic components and systems which are capable of performing, with high reliability, over wide-ranges of temperature and in the presence of intense radiation. The report describes current work dealing with a pulse actuation servo system, a pneumatic oscillator, the static modeling of fluid jet modulators, electrostatic pure fluid modulation, optimization of vortex valves, jet pipe inlet coupling, and the dynamic characteristics of gas thrust bearings. Author (TAB)

N66-24926*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
USE OF THE ADSORPTION HYDROGEN ELECTRODE AND THE OXYGEN FUEL-CELL ELECTRODE IN NICKEL-CADMIUM CELLS

Kenneth O. Sizemore Apr. 1966 30 p refs
(NASA-TM-X-55469; X-716-66-83) CFSTI: HC $2.00/MF $0.50 CSCL 10C

The characteristics of two types of auxiliary electrodes are investigated. The essentially linear response of the adsorption hydrogen's electrode voltage as a function of oxygen pressure and its stability in potassium hydroxide electrolyte makes it an ideal electrode for charge control. Although the oxygen fuel-cell electrode is a very good gas recombination electrode and better by a factor of 20 over the adsorption hydrogen electrode, it is difficult to use as a charge-control electrode because of its high sensitivity to oxygen pressure. Author

N66-24928*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AUXILIARY ELECTRODE INSTRUMENTATION FOR NICKEL CADMIUM CELLS
Kenneth O. Sizemore and Thomas J. Hennigan May 1966 26 p refs Presented at Power Sources Conf., 24–26 May 1966; Sponsored by Army
(NASA-TM-X-55471; X-716-66-200) CFSTI: HC $2.00/MF $0.50 CSCL 10C

This paper describes the use of an all-solid-state battery charge control system for nickel cadmium cells which employs auxiliary electrodes and a reconditioner to discharge all cells down to zero volt, in order to restore capacity lost by the "memory effect." The nickel cadmium battery is charged at a constant potential level of 1.46 volts per cell (at 25°C) by a shunt regulator until the threshold voltage of an auxiliary electrode is reached, indicating full charge. At this condition the auxiliary electrode signal can be used either to reduce the regulating level of the shunt regulator to a lower voltage level, or to control the conductance of a series transistor so that the battery is trickle-charged at a constant-current rate. Each cell of the battery contains an auxiliary electrode, which is capable of controlling the charge of the battery. Recent tests show that the electrode which first reaches the threshold level during early cycling continues to be the controlling electrode throughout the life of the battery. This suggests that it is not necessary to have a sensor on every cell. Author

N66-24963*# Marine Engineering Lab., Annapolis, Md.
SHUNT VOLTAGE REGULATOR CIRCUIT FOR NICKEL–CADMIUM CELLS WITH AUXILIARY ELECTRODES
Floyd E. Ford and Piotr P. M. Liwski Apr. 1966 42 p refs
(NASA Order S-12730-G)
(NASA-CR-74787; MEL-93/66) CFSTI: HC $2.00/MF $0.50 CSCL 10C

A circuit to control charge current entering nickel–cadmium cells with auxiliary electrodes (three-terminal cells) using a shunt method of control has been developed for use in satellite power systems requiring minimum weight and space with optimum control and temperature compensation. Reduction in charge current is caused when the set limits of either the total battery terminal voltage, or the potential of an auxiliary electrode of any individual cell, is exceeded. Author

N66-24976*# Unified Science Associates, Inc., Pasadena, Calif.
GASEOUS ELECTROLYTES FOR BATTERIES AND FUEL CELLS Sixth Quarterly Report, 21 Nov. 1965–20 Feb. 1966
S. Naiditch [1966] 46 p refs
(Contract NAS7-326)
(NASA-CR-74671) CFSTI: HC $2.00/MF $0.50 CSCL 10C

It is reported that conductivity cells designed for investigations of dense gaseous electrolytic solutions may be fabricated, within 1%, to a predetermined cell constant. Electromotive force data derived from two test runs of a conductivity cell are summarized and a comparison of this data indicated that the cell was reversible as well as reproducible. The inability to obtain quantitative agreement between cell constant measurements using mercury and those using KCl lead to a more detailed study of cell characteristics. As a result, the cell construction was modified so that cell constants could be determined by geometric measurements as well as by a dip rod technique. These considerations are discussed in detail, geometrical and conductivity data from three test cells are provided, and a comparison of resistance ratios with cross sectional ratios is made. H.S.W.

N66-24989*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
RADIATION EFFECTS ON SILICON SOLAR CELLS Technical Summary Report, May 16–Oct. 15, 1963
W. A. J. van Lint, J. W. Harrity, D. K. Nichols, and D. P. Snowden 4 Dec. 1963 56 p refs
(Contract NAS7-91; Proj. 258)
(NASA-CR-74712; GA-4797) CFSTI: HC $3.00/MF $0.50 CSCL 10A

This report describes research concerned with radiation effects on silicon solar cells. Measurements were made of excess carrier recombination in semiconductor samples over a range of carrier concentrations varying between 10^{2} and 10^{-4} times the equilibrium majority carrier concentration. Excess carrier lifetime was measured as a function of excess carrier concentration both before and after irradiation in 7 ohm-cm n-type silicon and in a 7 ohm-cm p-type samples. Measurements by electron spin resonance (ESR) techniques were made of the rate of production of A centers in silicon as a function of electron energy. A search was made by ESR techniques for other dominant resonance lines, particularly those which might be associated with the predominant recombination center. A reanalysis was made of previously generated data on rate of change of mobility with irradiation to determine the net rate of introduction of ionized impurity centers. A theoretical investigation was made of the statistics of electron-hole recombination for a single defect having two energy levels such that the second one is available only if the first one is already occupied. C.T.C.

N66-25017*# Manson (S.V.) and Co., Inc., Arlington, Va.
A STUDY OF FINNED TUBE GAS-TO-LIQUID HEAT EXCHANGERS FOR BRAYTON CYCLES IN SPACE
S. V. Manson Washington, NASA, Apr. 1966 182 p refs
(Contract NAS3-2535)
(NASA-CR-459) CFSTI: HC $5.00/MF $1.00 CSCL 10B

A study of gas-to-liquid heat exchangers was made for Brayton cycle powerplants in space. The function of the studied heat exchangers is to enable the cycle working gas to transfer the waste heat of the cycle to a liquid coolant. In the heat exchanger configuration considered, hot argon and hot neon flow across banks of externally finned tubes and transfer cycle waste heat to liquid NaK, lithium and water flowing inside the tubes. Heat exchangers were calculated for cycle power levels of 10 to 1000 KW_e. At high performance operating conditions, the heat exchangers were computed to have specific weights of about 1 lb/KW_e in a 1000 KW system, about 1.5 lb/KW_e in 500 and 100 KW systems, and about 3.5 to 5.5 lb/KW_e in a 10 KW system. Author

N66-25021*# Radio Corp. of America, Princeton, N. J.
CORRELATION OF DATA FROM TESTS ON NICKEL-CADMIUM BATTERIES Final Report
Irwin M. Schulman Washington, NASA, May 1966 43 p ref
(Contract NASw-1001)
(NASA-CR-480) CFSTI: HC $2.00/MF $0.50 CSCL 10C

The test data was studied in order to discern variabilities and patterns that could be used to develop statistical and phenomenological models for predicting the life expectancy of a cell. In addition, statistical and digital procedures were developed to determine: (1) the initial variability of cells, with respect to a variety of parameters; (2) time dependence of cell parameters; (3) time dependence of the variability of cell parameters; (4) the effect of the cell history upon the evolution of the values of cell parameters and their variability; and (5) whether the data obey a probability law. A Fortran computer program to be used on the RCA 301 system is outlined; and the use of the Kolmogorov-Smirnov statistic is discussed. D.T.

N66-25032# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Atomnoi Energii.
CERTAIN DATA ON INVESTIGATION OF PERFORMANCE OF THERMOEMISSION CONVERTER WITH AUXILIARY IONIZATION [NEKOTORYE DANNYE PO ISSLEDOVANIYU RABOTY TERMOEMISSIONNOGO PREOBRAZOVATELYA S DOPOLNITEL'NOI IONIZATSIEI]
Yu. Ay. Kravchenko and G. A. Stolyarov 1965 7 p In RUSSIAN
(IAE-950

The possibility of realization of a low-temperature thermoemission converter of thermal into electric energy is considered. Some experimental data on the effect of auxiliary ionization on the short-circuit current and the specific power of the converter are presented. Tests were carried out on an experimental converter in the interelectrode gap of which is located a filament made incandescent by a semi-rectified current. The short-circuit current and the specific power were increased 100- and 20-fold, respectively, for filament temperature up to 1640°C. Author (NSA)

N66-25063*# Globe-Union, Inc., Milwaukee, Wis.
A PROGRAM TO DEVELOP A HIGH-ENERGY DENSITY PRIMARY BATTERY WITH A MINIMUM OF 200 WATT HOURS PER POUND OF TOTAL BATTERY WEIGHT Seventh Quarterly Report, Jan. 1-Mar. 31, 1966
William E. Elliott, James R. Huff, Gerald L. Simmons, Guy D. Mc Donald, Judith L. Jamrozy et al 15 Apr. 1966 127 p
(Contract NAS3-6015)
(NASA-CR-54928) CFSTI: HC $4.00/MF $1.00 CSCL 10C

Characterization of electrode reactions using the linearly varying potential technique is described for lithium anodes and nickel hydroxide and silver oxide cathodes. Controlled current voltammetric studies of cupric fluoride cathodes were conducted in a variety of electrolytes. Seventy-two constant current discharges of full cells containing cobaltic fluoride, cupric fluoride, and silver oxide cathodes in $LiClO_4$-propylene carbonate and $LiPF_6$-N-nitrosodimethylamine electrolytes were completed. Limited testing of the organic cathode material, trichloroisocyanuric acid, was undertaken. Linearly varying potential scans of dimethylformamide, N-nitrosodimethylamine, and propylene carbonate electrolytes are presented to illustrate the extent of electrolyte interaction in full cell discharges. Compatibility studies for lithium, cupric fluoride, and silver oxide in $LiPF_6$-N-nitrosodimethylamine are described. Author

N66-25164*# American Cyanamid Co., Stamford, Conn. Research Labs.
DEVELOPMENT OF HIGH-PERFORMANCE LIGHT-WEIGHT ELECTRODES FOR HYDROGEN-OXYGEN FUEL CELLS Third Quarterly Report, 6 Oct. 1965-5 Jan. 1966
D. Gershberg, W. P. Colman, and J. Di Palma 15 May 1966 73 p refs
(Contract NAS3-6477)
(NASA-CR-54955) CFSTI: HC $3.00/MF $0.75 CSCL 10A

Progress is reported in the continuing development of high performance, lightweight electrodes for hydrogen-oxygen fuel cells. The initial performance and short term stability of a ceric oxide-polytetrafluoroethylene matrix were evaluated. An empirical model of pressure-temperature-KOH concentration effects on initial performance was developed from a computer analysis of data that was previously collected. The model permits predictions of cell voltage to within ±5-15 mv at 100-400 ma/cm^2, though not at 600-1000 ma/cm^2. The effect on initial performance of the fraction of product water removed at each electrode was investigated. It is reported that at 100-200 ma/cm^2, the highest initial voltages were obtained by removing all product water at the hydrogen electrode, and highest performance at 600-1000 ma/cm^2 occurred when two thirds or more of the product water was removed at the oxygen electrode. The results of small cell life tests are reviewed in detail and the large cell life testing is discussed. H.S.W.

N66-25215# Mechanical Technology Inc., Latham, N. Y.
EXPERIMENTAL TEST AND EVALUATION OF A GAS-BEARING BRAYTON CYCLE TURBOCOMPRESSOR Quarterly Progress Report, 1 Sep.-30 Nov. 1965
P. W. Curwen 17 Dec. 1965 112 p ref
(Contract AT(30-1)-3237)
(MTI-65TR64; NYO-3237-4) CFSTI: HC $4.00/MF $0.75

A description of the aerodynamic performance of the turbocompressor as determined from closed-loop tests using nitrogen as the cycle gas is presented. The performance of the bearing system is discussed along with the loop facility. Author

N66-25327# Argonne National Lab., Ill.
LIQUID MHD POWER CYCLE STUDIES
Michael Petrick and Kung-You Lee Jun. 1965 102 p refs
(Contract W-31-109-ENG-38)
(ANL-6954) CFSTI: HC $3.00/MF $0.75

The potential of liquid-metal MHD power cycles was investigated by means of extensive cycle studies and was found to be excellent. An overall efficiency of a binary cycle employing a liquid metal topping cycle and a bottoming steam cycle approaching 60% may be feasible. Detailed analyses and cycle data are presented. The potential of the binary cycle for commercial application is discussed. Author (NSA)

N66-25345# Mechanical Technology, Inc., Latham, N.Y.
EXPERIMENTAL TEST AND EVALUATION OF A GAS-BEARING BRAYTON CYCLE TURBOCOMPRESSOR Progress Report, 1 Mar.-31 Aug. 1965
P. W. Curwen and H. Schwarz 22 Sep. 1965 134 p refs
(Contract AT(30-1)-3237)
(MTI-65TR53; NYO-3237-3) CFSTI: HC $4.00/MF $0.75

The feasibility of, and problem areas associated with, the application of gas-lubricated bearings to closed-system gas turbine machinery are investigated. A Brayton-cycle gas generator (turbocompressor) utilizing self-acting gas bearings is designed and built, and is under test. Self-sustained closed-loop operation of the turbocompressor, using its own cycle

gas as the bearing lubricant, is achieved. The turbocompressor operations include tests at 1300°F (design point) turbine inlet temperature, at 24,000 rpm (design point) rotor speed, at 15 psia (design point) and 20 psia compressor inlet pressure, at compressor inlet temperatures from 70 to 135°F, at 2.01 (design point) compressor pressure ratio, and under compressor surge conditions. Problem areas are identified with respect to turbocompressor performance. Author (NSA)

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N66-23977# Buenos Aires Univ. (Argentina).
RADIATION DAMAGE IN MUSCLE MEMBRANES AND REGULATION OF CELL METABOLISM Annual Report, Jan. 1–Dec. 31, 1965
Adolfo Portela Dec. 1965 61 p refs
(Grant DA-ARO-49-092-65-671)
(Rept.-2; AD-629215) CFSTI: HC $3.00/MF $0.75

The report deals with studies of K and Cs ion effects on Na ion efflux and O_2 consumption in resting muscle cell; and the action of trypsin and phospholipase C in the presence of Cs or K Ringer's solution on resting membrane potential. Na efflux results are consistent with calculated differences in penetration rates of C and K ions. But O_2 consumption results are reversed from anticipated if considered a reflection of energy to drive the Na pump mechanism. Work has been done on membrane depolarization by various agents and their interaction and reversibility characteristics. Acetylcholine (ACh), ACh–Cs depolarizes membrane approaching a value of 55 mV. Or approximately the threshold action potential of membrane. This may be reversed by displacement by washing with K–Ringer. It is prevented by D–turbo-effect on Cs than K treated membrane. Tr does not alter capacity of ACh to evoke depolarization but alters its reversibility when Cs is substituted for K. A model receptor system and allosteric action mecanisms are discussed.
Author (TAB)

N66-24017# Naval Radiological Defense Lab., San Francisco, Calif.
X-RAY INDUCED GLOMERULOSCLEROSIS IN RATS: MODIFICATION OF LESION BY FOOD RESTRICTION, UNINEPHRECTOMY, AGE
Louis W. Wachtel, Leonard J. Cole, and Victor J. Rosen 11 Feb. 1966 20 p refs
(USNRDL-TR-977; AD-629512) CFSTI: HC $1.60/MF $0.50

The development of glomerulosclerosis was measured in the kidneys of rats under various conditions of irradiation and growth. Weanling rats whose kidneys were irradiated directly with 1,000 rad or 2,000 rad developed glomerulosclerotic lesions in 2 months; one-year old rats showed no evidence of lesions 2 months after irradiation with 2,000 rad. In the weanling rat the rapidity of development and severity of the glomerulosclerotic lesions were increased by growth or enlargement of the kidney subsequent to irradiation, and were slowed by growth retardation artificially produced through low-food intake. The induction of glomerulosclerosis by X-irradiation of the kidney is believed to be a latent result of damage to the kidney's vascular system, and that the effects of this damage are accentuated in the growing kidney.
Author (TAB)

N66-24046# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBLEMS OF RADIATION SAFETY OF SPACE FLIGHTS. PHYSICAL AND BIOLOGICAL INVESTIGATIONS WITH HIGH-ENERGY PROTON
Yu. G. Nefedova, ed. 27 Dec. 1965 231 p refs Transl. into ENGLISH of the book "Problemy Radiatsionnoy Bezopasnosti Kosmicheskikh Poletov. Fizicheskiye i Biologicheskiye Issledovaniya s Protonami Bol'shikh Energiy" Moscow, Atomizdat., 1964 p 1–239
(FTD-MT-65-159; AD-629421) CFSTI: HC $22.70/MF $1.25

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3. BIOLOGICAL ACTION OF PROTONS WITH AN ENERGY OF 510 MEV DURING MULTIPLE IRRADIATION p 51–93 refs (See N66-24049 13-04)
4. BIOLOGICAL ACTION OF PROTONS WITH AN ENERGY OF 510 MEV DURING SINGLE IRRADIATION p 94–129 refs (See N66-24050 13-04)
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9. COMPARATIVE ANALYSIS OF THE BIOLOGICAL ACTION OF PROTON RADIATION WITH AN ENERGY OF 510 MEV p 182–193 (See N66-24055 13-04)
10. PROPHYLAXIS AND TREATMENT OF RADIATION INJURIES CAUSED BY THE ACTION OF PROTONS p 194–220 refs (See N66-24056 13-04)

N66-24047# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FEATURES OF THE RADIATION EFFECT IN SPACE FLIGHT CONDITIONS AND MEANS OF DEVELOPING PERMISSIBLE RADIATION LEVELS
In its Probl. of Radiation Safety of Space Flights. Phys. and Biol. Invest. with High-Energy Proton 27 Dec. 1965 p 3–20 refs (See N66-24046 13-04) CFSTI: HC $22.70/MF $1.25

The action of intense radiation fields from X-rays and γ-sources, as well as from charged high energy particles during manned space flight conditions were analyzed, and permissible

radiation levels for the human body in planetary and circumferential space exploration were established. Dosage estimates were made by computations of the absorbed particle energy in an isolated gram of human tissue. Biological danger was estimated for primary and secondary cosmic radiation, penetrating radiation from solar flares, and electron and bremsstrahlung effects of the outer and inner radiation belts of the earth. Permissible dosages of 50 rem during space-flights lasting from several days to one year, and of 25 to 30 rem per year for a flight lasting several years were found. Individual radiosensitivity of the human subjects should be considered in the selection of astronauts. G.G.

N66-24049# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

BIOLOGICAL ACTION OF PROTONS WITH AN ENERGY OF 510 MeV DURING MULTIPLE IRRADIATION

In its Probl. of Radiation Safety of Space Flights. Phys. and Biol. Invest. with High-Energy Proton 27 Dec. 1965 p 51–93 refs (See N66-24046 13-04) CFSTI: HC $22.70/MF $1.25

Physical conditions were created for irradiation of dogs and rats by high energy protons, tissue doses were computed, and analyses of the radiation composition in the animals was conducted. Biological action of high energy protons in fractional irradiation at energies of 510 Mev at doses of 250 to 650 rad for dogs, and at 100 to 1200 rad for rats showed progressive radiation sickness syndromes with the characteristic functional and morphological disturbances. Biological action of the protons was less expressed in the reaction of the peripheral blood and bone marrow as compared with γ- and X-radiation; however, in later periods serious changes in the blood picture appeared with full aplastic anemia and subsequent death of the animals. Animals irradiated on a faster schedule showed a more acute development of the radiation disease. Morphological examinations of animal cadavers established the typical hemorrhagic syndromes in all internal organs, especially in all sections of the brain. G.G.

N66-24050# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

BIOLOGICAL ACTION OF PROTONS WITH AN ENERGY OF 510 MeV DURING SINGLE IRRADIATION

In its Probl. of Radiation Safety of Space Flights. Phys. and Biol. Invest. with High-Energy Proton 27 Dec. 1965 p 94–129 refs (See N66-24046 13-04) CFSTI: HC $22.70/MF $1.25

Single irradiation experiments on dogs and rats exposed to proton energy of 510 Mev and different rad dosages, were reported. All dogs developed acute radiation sickness after a certain latent period, depending on the size of the dose. Developing pathomorphological changes were similar to acute radiation symptoms caused by X-rays of γ-rays; most characteristic were multiple hemorrhages in the subcutaneous cellular tissues of the trunk and neck, and also in the internal organs and tissues of the body. Radiation sickness developing in rats after proton irradiation with an energy of 510 Mev in doses up to 400 rad was mild and did not lead to exitus; a climax in radiation sickness symptoms was found from the 3rd through the 10th day after exposure, with hemorrhagic diathesis and reduction of the lymphoid apparatus of the spleen. Later, by the first 2 weeks after irradiation, regeneration of lymphocytes and partial restoration of the rat follicles were observed. G.G.

N66-24051# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

BIOLOGICAL ACTION OF PROTONS WITH AN ENERGY OF 126 MeV ON THE CORNEAL EPITHELIUM OF MICE

In its Probl. of Radiation Safety of Space Flights. Phys. and Biol. Invest. with High-Energy Proton 27 Dec. 1965 p 130–139 refs (See N66-24046 13-04) CFSTI: HC $22.70/MF $1.25

Physiological tissue regeneration in the corneal epithelium of mice, exposed to proton irradiation with an energy of 126 Mev, was studied to determine the relative biological effectiveness of radiation. Irradiation in doses of 200 rad and 500 rad caused inhibition of mitotic activity, a decrease of the quantity of cells and the appearance of pathological forms of mitosis. As the irradiation dosage increased, the degree of suppression of mitotic activity increased, and the intensity of the restoring processes dropped. Analyses of chromosomal aberration disappearances from the corneal epithelium of the irradiated animals led to the assumption that the RBE of high energy protons, as determined by the distant consequences of irradiation, can be higher than the RBE determined on the basis of early reactions. G.G.

N66-24052# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DETERMINATION OF THE BIOLOGICAL ACTION OF PROTONS WITH AN ENERGY OF 510 eV AND X-RAYS WITH AN ENERGY OF 180 kV ON HEREDITARY STRUCTURES

In its Probl. of Radiation Safety of Space Flights. Phys. and Biol. Invest. with High-Energy Proton 27 Dec. 1965 p 140–145 refs (See N66-24046 13-04) CFSTI: HC $22.70/MF $1.25

The relative biological efficiency (RBE) of protons with an energy of 510 Mev, and of X-rays with an energy of 180 kv was studied by observing the frequency of appearance of dominant lethals in the irradiated sex cells of the hereditary structures in rats and dogs. It was found that the RBE coefficient of protons with an energy of 510 Mev, with respect to general action and with determination of the lethal and 50% dose of survival for 30 to 60 days, was about 0.7 for rats and about 1.0 for dogs. Small doses of protons were biologically more effective than corresponding doses of X-rays in rats; but an inverse relationship was observed with large doses of protons and X-rays. G.G.

N66-24053# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

BIOLOGICAL ACTION OF PROTONS WITH AN ENERGY OF 130 MeV, X-RAYS WITH AN ENERGY OF 180 KV, and Co^{60} GAMMA-RADIATION ON THE VESTIBULAR ANALYZER

In its Probl. of Radiation Safety of Space Flights. Phys. and Biol. Invest. with High-Energy Proton 27 Dec. 1965 p 146–171 refs (See N66-24046 13-04) CFSTI: HC $22.70/MF $1.25

Experimental data for the influence of ionizing radiation on the activity of the vestibular analyzer in labyrinthectomized dogs and rabbits were obtained after their exposure to high energy protons and gamma radiation. Corresponding numerical ratios were established between the radiation dose and the biological effect by observing the intensity and duration of caloric nystagmus. An increase in ionizing radiation dosage lowered the excitability of the animals' nervous systems. However, a single small dose of about 50 r to 100 r increased the excitability of their vestibular analyzer. G.G.

N66-24054# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

BIOLOGICAL ACTION OF MULTIPLEX-IRRADIATION WITH AN ENERGY OF 180 KV COMPARED TO PROTON IRRADIATION IN DOSES AND TIME DISTRIBUTION

In its Probl. of Radiation Safety of Space Flights. Phys. and Biol. Invest. with High-Energy Proton 27 Dec. 1965 p 172–181 (See N66-24046 13-04) CFSTI: HC $22.70/MF $1.25

Biological effects of radiation injuries caused by fractional multiple proton and X-ray exposures were studied by corresponding irradiations of dogs and rats with an energy of 180 kv. Multiple irradiation to a cumulative dose of 613 r to 667 r resulted in acute radiation sickness of the dogs with sharply expressed hemorrhagic syndromes. Rats developed a milder case of radiation sickness with death of some animals. At a cumulative dose of 1015 r, 22% of the rats died in two months and 60% at later periods. Blood changes were in both groups identical. G.G.

N66-24055# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

COMPARATIVE ANALYSIS OF THE BIOLOGICAL ACTION OF PROTON RADIATION WITH AN ENERGY OF 510 MeV

In its Probl. of Radiation Safety of Space Flights. Phys. and Biol. Inves. with High-Energy Proton 27 Dec. 1965 p 182–193 (See N66-24046 13-04) CFSTI: HC $22.70/MF $1.25

Clinical manifestations of radiation sickness in dogs, as a result of fractional exposure to protons (510 Mev) and to X-radiation (180 kv), developed in acute form with a sharply expressed hemorrhagic syndrome. At the same time, the average life duration of the dogs after fractional X-irradiation was longer than the average life duration after a single irradiation at the same dosage. The RBE coefficient of proton irradiation for both conditions was equal. Data obtained for fractional irradiation of rats showed a higher effective death rate for X-irradiation. The RBE coefficient of fractional proton irradiation was established as equal to 0.8. G.G.

N66-24056# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PROPHYLAXIS AND TREATMENT OF RADIATION INJURIES CAUSED BY THE ACTION OF PROTONS

Inits Probl. of Radiation Safety of Space Flights. Phys. and Biol. Invest. with High-Energy Proton 27 Dec. 1965 p 194–220 refs (See N66-24046 13-04) CFSTI: HC $22.70/MF $1.25

Prophylaxis and therapy of radiation injuries caused by exposure of mice and dogs to gamma and X-ray irradiation were studied by the comparative effectiveness of radioprotective chemical preparations, curative means, and therapeutic methods. The most pronounced defensive action was obtained by the combined action of 5-hydroxytryptamine and a combination of cystamine and amygdalin; especially 5-hydroxytryptamine showed good anti-hemorrhagic action in proton irradiation. An effective protective–curative complex consisting of animal acclimatization to a low oxygen atmosphere and oral administration of cystamine and amygdalin one hour before irradiation showed definite curative properties against proton damage; however, this protective complex did not prevent the development of a plastic anemia in the animals at a later date. G.G.

N66-24064# Bionetics Research Labs., Inc., Falls Church, Va.

THE NEED FOR CRITICAL EVALUATION OF CHOICE OF ANIMAL SPECIES FOR CONTINUOUS INHALATION EXPOSURE EXPERIMENTS

J. R. M. Innes *In* Aerojet-Gen. Corp. Proc. of the Conf. on Atmospheric Contamination in Confined Spaces [1965] p 34–45 refs (See N66-24060 13-05) CFSTI: HC $7.00/MF $1.50

The need to maintain disease free laboratory animals for continuous inhalation experiments involves constant supervision and awareness of disorders that can develop spontaneously. Incidence of chronic murine pneumonia and infectious catarrhs in experimental rats leads to a high infection rate. Monkeys are very susceptible to acute pulmonary diseases caused by a variety of pathogenic bacteria; tuberculosis especially is a problem of great magnitude in monkey colonies. It is recommended that imported *Macaca mulatta* should not be used for chronic studies as they have some degree of mite infestations and lung lesions. Studies proved that lung mites from monkeys can survive in the lungs of abnormal hosts for some time, and that cross-infestation between monkeys and other mammals (even man) may be possible. G.G.

N66-24065# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.

CLINICAL LABORATORY METHODS

Mildred K. Pinkerton *In* Aerojet-Gen. Corp. Proc. of the Conf. on Atmospheric Contamination in Confined Spaces [1965] p 46–57 refs (See N66-24060 13-05) CFSTI: HC $7.00/MF $1.50

Some clinical laboratory methods and terms for use in continuous inhalation exposure studies are discussed that involve colorimetric analysis and measurements by spectrophotometry. Criteria for selected procedures were economy, ease of performance, speed of obtaining results, reproducibility or precision, sample size required, inherent laboratory error, and general acceptance of the specific principle involved. The more common biochemical serum components along with the general principles of the recommended methods are listed in a table; also shown are the experimentally proven stabilities of several serum components. G.G.

N66-24066# School of Aerospace Medicine, Brooks AFB, Tex. Psychological Chemistry Section.

EXPERIMENTAL BIOLOGICAL AND BIOCHEMICAL PARAMETERS

Johnie L. Reeves *In* Aerojet-Gen. Corp. Proc. of the Conf. on Atmospheric Contamination in Confined Spaces [1965] p 58–65 refs (See N66-24060 13-05) CFSTI: HC $7.00/MF $1.50

Regularly scheduled and frequent examinations of laboratory animals used in environmental toxicology experiments are advocated. Animal observations should include the general behavior patterns; unusual pupillary size and reactions; conditions of the conjunctivae, of the skin, and of the oral mucous membranes; and studies of the breathing rate, the character of breathing, and chest sounds. Most of the recommended laboratory procedures relate to specimens of venous blood. G.G.

N66-24067# Dow Chemical Co., Midland, Mich. Biochemical Research Lab.

GROSS AND HISTOPATHOLOGICAL EVALUATION

Howard C. Spencer *In* Aerojet-Gen. Corp. Proc. of the Conf. on Atmospheric Contamination in Confined Spaces [1965] p 66–73 (See N66-24060 13-05) CFSTI: HC $7.00/MF $1.50

A systematic dissection during autopsies of laboratory animals exposed to environmental toxic atmospheres should describe observed gross lesions by their location, severity, extent, and size. In addition to the respiratory system, the criteria of growth—liver and kidney weight, and liver and kidney histopathology—should be extended to include lung weight, lung gross, and lung histopathology. Continuous inhalation exposure studies should also include recordings of the heart and testes, spleen, and adrenal weight and pathology; bone marrow investigations should be included if indicated by peripheral hematology. G.G.

N66-24068# Ohio State Univ., Columbus. Dept. of Mathematics.

STATISTICAL METHODS IN TOXICOLOGICAL RESEARCH

J. S. Rustagi *In* Aerojet-Gen. Corp. Proc. of the Conf. on Atmospheric Contamination in Confined Spaces [1965] p 77–85 refs (See N66-24060 13-05) CFSTI: HC $7.00/MF $1.50

Discussed are those statistical techniques which are especially relevant to the effects of contaminated atmospheres on animals in confined spaces. Comparison of two populations establishes the effect of certain environmental conditions on physiological changes in blood and tissues of various animals by denoting blood variables as $X_1, X_2, \ldots, X_k$ where the components of X are stochastically dependent and have multivariate distribution, and where k constitutes any blood variable like number of red blood cells, amount of sodium, etc. Effects of exposure to chemicals, gases, and other environmental factors can thus be statistically evaluated by comparing the control groups with the treated groups. G.G.

N66-24069# Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.

PERFORMANCE MEASURES DURING EXPOSURE TO TOXIC ENVIRONMENTS

Herbert H. Reynolds *In* Aerojet-Gen. Corp. Proc. of the Conf. on Atmospheric Contamination in Confined Spaces [1965] p 86–97 refs (See N66-24060 13-05) CFSTI: HC $7.00/MF $1.50

Psychological work in toxicological environmental animal research pertains to experiment design considerations, choice of species and sample size, selection of performance tasks and the training of subjects, and data acquisition and evaluation. Performance schedules should encompass the following criteria: (1) vision and hearing stimuli; (2) responses involving those nervous system areas that are potentially critical to toxicological–physiological studies; (3) elastic performance schedules to ensure manageable training problems; and (4) the capability of the animal. An example monkey performance schedule for a 30-day test in a 100 percent O_2, 5 psi environment is presented, and the stimulus-response panel for this schedule is shown. G.G.

N66-24070# Aerojet-General Corp., Dayton, Ohio. Toxic Hazards Research Unit.

PRELIMINARY RESULTS OF TOXICITY STUDIES IN 5 PSIA 100% OXYGEN ENVIRONMENT

James M. Mc Nerney *In its* Proc. of the Conf. on Atmospheric Contamination in Confined Spaces [1965] p 98–123 (See N66-24060 13-05) CFSTI: HC $7.00/MF $1.50

A 90-day exposure study of mice, rats, beagles, and monkeys to a 5 psia and 100% oxygen environment produced the following results: (1) Wistar rats were sensitive to altitude conditions early in the exposure and showed a 15% mortality within 14 days; Sprague-Dawley rats proved more resistant; and (2) a possible association of increased serum glutaminic pyruvic transaminase levels in beagles with length of exposure was found. No significant increases in the toxic responses of animals to inhaled atmospheric contaminants (carbon tetrachloride, nitrogen dioxide, and ozone) were observed under conditions of 5 psia and 100% oxygen. Based upon mortality rates, a definite reduction in toxic response to pulmonary irritants was found at a reduced pressure 100% oxygen atmosphere when compared with a similar atmosphere at ambient pressure. G.G.

N66-24071# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.

REVIEW OF AIR FORCE DATA FROM LONG TERM CONTINUOUS EXPOSURE AT AMBIENT PRESSURE

Kenneth C. Back *In* Aerojet-Gen. Corp. Proc. of the Conf. on Atmospheric Contamination in Confined Spaces [1965] p 124–133 (See N66-24060 13-05) CFSTI: HC $7.00/MF $1.50

Work on environmental toxicology of space cabin atmospheres over the past 5 years centered on the development of toxicity criteria for various animals, and its standardization in the so-called Industrial Threshold Limit Values (TLT). Reported are experiments on monkeys, rats, and mice to test these established tolerable contaminant levels in various contaminated atmospheres over differing lengths of times. It was shown, that carbon tetrachloride, while not causing death at 25 ppm, did produce serious clinical and microscopical liver changes in all exposed animals; phenol had no toxic effects at the 5 ppm level. A summary of observed animal mortality rates in continuous toxicity exposure to hydrazine, UDMH, nitrogen dioxide, and decaborane established hydrazine as the most toxic agent for rats and mice; decaborane was less species effective; and UDMH was better tolerated than either hydrazine or decaborane by all animals. Monkeys showed great tolerance towards nitrogen dioxide. G.G.

N66-24072# Naval Medical Research Inst., Bethesda, Md. Navy Toxicology Unit.

REVIEW OF AMBIENT PRESSURE ANIMAL EXPOSURE DATA FROM SELECTED NAVY COMPOUNDS

Jac Siegel *In* Aerojet-Gen. Corp. Proc. of the Conf. on Atmospheric Contamination in Confined Spaces [1965] p 134–147 (See N66-24060 13-05) CFSTI: HC $7.00/MF $1.50

Reviewed are parametric studies, evaluated materials, and the animal species mortality rates obtained during a five year study on chronic and acute inhalation toxicity of guinea pigs, rats, rabbits, monkeys, and dogs. Emphasis was placed on results from atmospheres containing oxyfants and hydrocarbons. Accumulative data based on 30-, 60-, and 90-day exposures to carbon tetrachloride reached a 20% mortality in guinea pigs after 90 days; atmospheric ozone concentrations increased guinea pig mortality also, and a nitrogen dioxide containing atmosphere showed mortality effects for both, guinea pigs and rats. G.G.

N66-24073# Public Health Service, Cincinnati, Ohio.

LONG TERM INHALATION EXPOSURE EXPERIENCE WITH REFERENCE TO AIR POLLUTION

F. Gordon Heuter *In* Aerojet-Gen. Corp. Proc. of the Conf. on Atmospheric Contamination in Confined Spaces [1965] p 148–165 (See N66-24060 13-05) CFSTI: HC $7.00/MF $1.50

Examined were the long term exposure effects on dogs, guinea pigs, and rats to an atmosphere polluted by raw oil exhausts and also by irradiated oil exhausts which simulated the photochemistry that occurs during sunlight and causes a reaction of the exhaust mixture. In general, there were no statistically significant effects of auto exhaust atmospheres with

respect to mortality, growth, immunology, blood gas analyses, or oxygen consumption; but significant effects in terms of susceptibility to infection with increasing age, and spontaneous activity were found. Mouse fertility decreased markedly and fewer litters were born. Bone lead analyses on sacrificed mice showed increased bone lead accumulation with increased auto exhaust concentrations in the atmosphere. G.G.

N66-24074# National Academy of Sciences—National Research Council, Washington, D. C.

PROBLEMS IN THE INTERPRETATION AND EXTRAPOLATION OF ANIMAL DATA TO MAN

Harry W. Hays *In* Aerojet-Gen. Corp. Proc. of the Conf. on Atmospheric Contamination in Confined Spaces [1965] p 166–173 (See N66-24060 13-05) CFSTI: HC $7.00/MF $1.50

A brief review of the evolution of animal experimentation and on predictability of toxicity in man is given, and some of the problems are outlined that make interpretation and extrapolation of animal data to man difficult. Extension of animal test data to man rests foremost on the careful selection of species for application to a special research problem; more studies in metabolism are needed to make data interpretation meaningful. In addition, preplanning and regular periods of assessment together with better analytical methods, especially in inhalation work, were considered of importance to improve predictability. G.G.

N66-24114*# Washington State Univ., Pullmann. Primate Research Center.

ULTRASOUND AND PHAKOMETRY MEASUREMENTS OF THE PRIMATE EYE Technical Report, Aug. 1965

Francis A. Young, George A. Leary, and Donald N. Farrer Holloman AFB, N. Mex., 6571st Aeromed. Res. Lab., Feb. 1966 33 p refs

(NASA Order R-25; Grant PHS-NB-05459-01)

(NASA-CR-74013; ARL-TR-66-5) CFSTI: HC $2.00/MF $0.50 CSCL 06C

Results obtained on 160 eyes of 53 male and 40 female chimpanzees ranging in age from 2 to 15 years, using ultrasonography and photographic ophthalmophakometry to measure anterior chamber depth, lens thickness, and axial length, are compared with the results obtained on 140 human eyes of a comparable sex grouping using the same methods. The intercorrelations between methods are not quite as high on the chimpanzees as on the humans, but the correlations between the measures of axial length and the vertical ocular refraction are virtually identical for the two groups. Either ultrasound or photographic ophthalmophakometry may be used successfully on primates and will yield results which compare favorably with those obtained on humans, but ultrasound is the method of choice since it does not require as much time to make the measurement or to calculate the result as does phakometry. Further, it does not require the rigid degree of control over the animal's behavior that phakometry requires and its flexibility allows measurement in situations in which it would be impossible to obtain phakometry measurements. Thus for both human and animal work, ultrasound is generally superior to phakometry. Author

N66-24123*# Naval School of Aviation Medicine, Pensacola, Fla.

ENERGY DISSIPATION CHARACTERISTICS IN TISSUE FOR IONIZING RADIATION IN SPACE Progress Report No. 13, 1 Dec. 1965–28 Feb. 1966

Hermann J. Schaefer [1966] 3 p

(NASA Order R-75)

(NASA-CR-71812) CFSTI: HC $1.00/MF $0.50 CSCL 06R

When exposed to radiation from solar particle beams under conditions of light shielding, it was considered that the radiation dose in the skin will be the limiting factor as far as permissible exposure is concerned. Studies were undertaken to analyze the pertinent dose distributions both on the rad and rem dose level. The relative biological effectiveness factors of the alpha and medium heavy component of flare beams was also of major interest. Three representative spectra were selected with rigidity gradients corresponding to P_0 values of 50, 125, and 300 Mv in the exponential formula $J=J_0 \exp(-P/P_0)$ for the integral spectrum. The data derived from these studies showed that the contributions of the alpha and medium heavy component to total dose grow substantially as P_0 grows. The rad doses in the skin for a normalized proton dose rate of 100 rads/hr are listed and the magnification of dose fractions, from the heavy components, if rad doses are converted to rem doses is discussed. H.S.W.

N66-24124# Hawaii Univ., Honolulu. Pacific Biomedical Research Center.

A COMPARISON, UNDER ARCTIC SURVIVAL CONDITIONS, OF A PEMMICAN-TYPE MEAT BAR WITH AN ISOCALORIC RATION OF SUCROSE PLUS ELECTROLYTES Progress Report, 1 Jan.–1 Jun. 1964

Terence A. Rogers, James A. Setliff, Alan C. Buck, and Milton Matter, Jr. Ft. Wainwright, Alaska, Arctic Aeromed. Lab., Nov. 1965 16 p refs

(Contract AF 41(609)-1918)

(AAL-TR-65-11; AD-628898) CFSTI: HC $1.60/MF $0.50

The basis of current arctic survival ration is pemmican or a meat bar composed of powdered lean meat mixed with fat. The present experiment compares, under survival conditions, metabolic changes in men fasting completely, men receiving sucrose and electrolyte supplements, and men receiving the meat bar. Eighteen men divided into three groups of six men each, ate a standard diet of USAF IF No. 10 rations in barracks for two days, then underwent a seven-day simulated survival situation. Isocaloric intake of pemmican at this level did not appear to have any great advantage over simple starvation, whereas sucrose with a sodium salt supplement prevented or ameliorated some of the symptoms of starvation. It was concluded that although the caloric density and high protein content of pemmican are advantageous to fully-fed men, pemmican is inferior to sucrose plus sodium salts for severely limited calorie regime. Author (TAB)

N66-24128# Joint Publications Research Service, Washington, D. C.

BIONICS

M. G. Gaaze-Rapoport and V. E. Yakobi, ed. 20 Apr. 1966 633 p refs Transl. into ENGLISH of the book "Bionika" Moscow, Navka Publ. House, 1965 p 1–474

(JPRS-35125; TT-66-31562) CFSTI: $9.10

Pattern recognition and learning machines, simulation of neuron networks, and capabilities of various biological systems are considered in terms of applicability to the design of engineering devices and systems. For individual titles see N66-24127–N66-24200.

N66-24146# Joint Publications Research Service, Washington, D. C.

THE PHYSIOLOGY OF THE CHEMORECEPTOR SENSILLAE OF INSECTS

Yu. A. Yelizarov *In its* Bionics 20 Apr. 1966 p 154–165 refs (See N66-24126 13-04) CFSTI: $9.10

Specificity of the response of individual receptor sensilla on the labellae of the proboscis of the Stomoxys calcitrans fly was determined in a wide range of concentrations of various stimulants, namely sodium chloride, glucose, and insect repellents. In large concentration, NaCl excites one sensory cell, while glucose another type; the repellents act exclusively on the receptors specific to NaCl. The simplest chemoreceptor sensillae have two specific receptors: both S- and L-receptors, and the possibility of a system for showing this is proposed. M.W.R.

N66-24147# Joint Publications Research Service, Washington, D. C.

STRUCTURAL ORGANIZATION OF THE OLFACTORY RECEPTOR OF FISH

N. V. Bodrova *In its* Bionics 20 Apr. 1966 p 166–173 refs (See N66-24126 13-04) CFSTI: $9.10

Experimental-morphological investigations were conducted of the olfactory organs in fish by impregnation of the cerebrum with methyl blue to gain information about the behavior of the organism and, apparently, with the possibility of simulating the olfactory organ itself. Although three forms of receptor neurons, (thread, rod, and cone shaped) are present in all fish, there appear to be differences in the total number of neurons, their individual shapes and structures, and in the nature of their localization in the epithelium. Details are presented for studies relating to the olfactory bulb of the perch, bream, and burbot. M.W.R.

N66-24155# Joint Publications Research Service, Washington, D. C.

ON THE CONCEPT OF RESONANCE PROCESSES IN THE MECHANISM OF PHOTORECEPTION

I. S. Brit *In its* Bionics 20 Apr. 1966 p 237–239 (See N66-24126 13-04) CFSTI: $9.10

Mechanisms of similar resonance processes in photoreceptors are discussed briefly in general terms. Inasmuch as the bulk of an elementary disc in a receptor is practically closed, it is considered according to the classical electromagnetic theory as dielectric. It is assumed that the elementary disc from the outer section or the disc of the mitochondria may be excited by predetermined wavelengths as in an oscillatory system with distributed constants. The outer sections and nuclei of their receptors react as resonators not to the visual spectrum but to infrared radiation. The basic resonance frequencies of a large number of mitochondria contained in the inner section, however, correspond to the visible spectrum. There is still some question as to whether the bundle of fibrils located between the outer and inner segments of the receptor is a nonlinear element of a system, such as a mixer, frequency factor, or a modulator. M.W.R.

N66-24156# Joint Publications Research Service, Washington, D. C.

SOME PROBLEMS IN AERODYNAMICS AND HYDRODYNAMICS OF BIRDS AND ANIMALS

S. Ye. Kleynenberg *In its* Bionics 20 Apr. 1966 p 240–244 refs (See N66-24126 13-04) CFSTI: $9.10

Various observations relating to the flight of birds and the movement of mammals are mentioned in relation to possible applicability to bionics and the consequent development of usable and reliable devices. Observations of some unusual feats are noted with regard to aerodynamics and hydrodynamics. M.W.R.

N66-24157# Joint Publications Research Service, Washington, D. C.

INVESTIGATIONS OF THE FUNCTIONAL MORPHOLOGY OF FISH

Yu. G. Alexyev *In its* Bionics 20 Apr. 1966 p 245–251 refs (See N66-24126 13-04) CFSTI: $9.10

More than 200 species of fish, ecologically and morphologically quite different, were studied to compare their outer structures, accommodations relating to camouflaging, and the hydrostatics of the organisms. For the latter specific weight and buoyancy of the fish and their individual organs were determined. While details of the results are not presented, it is concluded that the devices relating to motion are represented by three large complexes which are concerned with: (1) neutralization of the effect of gravity, (2) forward motion, and (3) control of all motion. Development of propelling organs and other external structures is considered from an evolutionary point of view, that is, in the direction of increasing speed and adaptability. M.W.R.

N66-24158# Joint Publications Research Service, Washington, D. C.

LIVING MODELS OF AUTONOMIC FLOATING STRUCTURES IN THE OCEAN

A. I. Savilov *In its* Bionics 20 Apr. 1966 p 252–262 refs (See N66-24126 13-04) CFSTI: $9.10

Structural properties of the bodies of two coelenterates, velella and physalia, are observed because they use the force and direction of the prevailing winds to accelerate their movement in the ocean. Both forms have well developed organs which remain above the water and act as sails; the pneumatophore of the physalia is a large thin-walled vesicle filled with air and may be compared to the hull of a sailing sloop. A bundle of especially long main dactylozoids may be compared with a floating anchor thrown into the water from the stern of the sloop, and similar analogies can be drawn for other parts of the physalia. The velella, on the other hand, is compared to a raft which is equipped with keel and sail. It is considered that information about such organisms may be of use in engineering and technology investigations, and it is suggested that specific applications may be for the development of models of automatic weather monitoring stations which can remain in the ocean for long periods of time. M.W.R.

N66-24159# Joint Publications Research Service, Washington, D. C.

HYDRODYNAMIC ASPECTS OF STUDYING THE MOVEMENT OF AQUATIC ANIMALS

S. V. Pershin *In its* Bionics 20 Apr. 1966 p 263–273 refs (See N66-24126 13-04) CFSTI: $9.10

Structural characteristics and movements are investigated for mackerel-type fish, dolphins and whales, various cephalopods, and other aquatic animals; and the hydrodynamic aspects of the motion are summarized. In contrast to the way man-made sea vehicles travel, all natural submarine inhabitants have their motors and propellers in one mechanism to facilitate effective output of energy. This motion is always nonstationary and cyclical, but varies with the species; and various means are used to decrease the hydrodynamic resistance of the water and to control laminarization of the so-called boundary layer. Findings such as these are considered to have applicability in the construction of biohydrodynamic experimental devices and systems. M.W.R.

N66-24160# Joint Publications Research Service, Washington, D. C.

CHARACTERISTICS OF THERMAL CONTROL IN AN AQUATIC ENVIRONMENT (USING MAMMALS AS AN EXAMPLE)

V. M. Bel'kovich *In its* Bionics 20 Apr. 1966 p 274–279 refs (See N66-24126 13-04) CFSTI: $9.10

Various aspects of heat control in aquatic mammals are considered in terms of applications to technical problems, including (1) long-term storage of an interstitial air layer, (2) use of temperature gradient in heat exchangers, (3) staged and pulsating passage of the heat carrier in a heat exchanger, and (4) construction of light autonomic diving suits and submarines with soft hull coverings. It is pointed out that thermal insulation of land animals is usually accomplished by hair coverings; semiaquatic animals leave only the extremeties, tail, and certain part of the head uncovered; and since there are greater numbers of blood vessels in these parts, the thermal insulation is thereby accounted for. With the increase in length of time the species spends in the water, the thermal insulation seems to shift from the surface to the integument itself. For mammals which live in water constantly, the hair covering disappears almost completely, the outer layer of the skin increases in thickness, and there is more fatty layer.

M.W.R.

N66-24161# Joint Publications Research Service, Washington, D. C.

SOME ASPECTS OF THE PROBLEM OF DEEP-SEA AUTONOMIC DIVING OF MAN IN THE LIGHT OF INVESTIGATIONS IN THE BIOLOGY OF DIVING MAMMALS

A. V. Yablokov *In its* Bionics 20 Apr. 1966 p 280–288 refs (See N66-24126 13-04) CFSTI: $9.10

Various characteristics of diving mammals are noted, and an attempt is made to relate these findings to applications of deep sea diving by humans. Essential basic areas for work involved during autonomic diving by man are discussed, and the simulation of structures and functions of cetaceans is considered. Both the biochemical aspects and the effects of pressure are investigated.

M.W.R.

N66-24162# Joint Publications Research Service, Washington, D. C.

ACCOMMODATIONS IN THE PLUMAGE OF BIRDS FOR STREAMLINING AIR CURRENTS

T. L. Borodulina *In its* Bionics 20 Apr. 1966 p 289–296 refs (See N66-24126 13-04) CFSTI: $9.10

While the speeds required for aircraft flight are considerably greater than those of birds, the accommodations in the plumage of birds for streamlining air currents is discussed in terms of applicability to bionics and technological synthesis. Following an investigation of various feathers, it is concluded that the filament feathers on the body and wings of birds probably contain a receptor function and should be studied further for possible use in the simulation of engineering systems.

M.W.R.

N66-24163# Joint Publications Research Service, Washington, D. C.

PROCEDURES FOR THE INVESTIGATION OF THE FLIGHT OF BIRDS TO DISCOVER THE PHYSICAL LAWS OF FLIGHT USING FLAPPING WINGS

N. V. Kokshayskiy *In its* Bionics 20 Apr. 1966 p 297–307 refs (See N66-24126 13-04) CFSTI: $9.10

The use of flapping wings by birds in flight is considered to offer the possibility of discovering new physical laws relating to flight and aerodynamics. Yet, flight is regarded as a part of the complex biological system which must be interrelated to other vital activities in order to obtain results which might be of use in the development of engineering systems. Energy expended by birds and other physiological indices are discussed, and the simulation of models of biological materials and systems is mentioned.

M.W.R.

N66-24164# Joint Publications Research Service, Washington, D. C.

ORIENTATION AND NAVIGATION IN THE ANIMAL WORLD

B. P. Manteufel, N. P. Naumov, and V. E. Yakobi *In its* Bionics 20 Apr. 1966 p 308–315 refs (See N66-24126 13-04) CFSTI: $9.10

Various levels of spatial orientation in animals are investigated in terms of bionic applications, particularly as applied to the development of self-orienting and self-directing man-made systems. The simulation of receptor systems is considered of particular interest for both types of systems, and various sensory organs of animals are discussed. The location phenomenon in bats is reported, and the ultrasonic impulses of bats in flight is mentioned. It is noted that a bat may detect a wire as narrow as 0.175 mm in cross section. So-called echo-location is noted for birds in caves and other environments, as is the low frequency electromagnetic vibrations in fish. Migration in birds is discussed in general terms.

M.W.R.

N66-24166# Joint Publications Research Service, Washington, D. C.

SOME RESULTS FROM REMOTE OBSERVATIONS OF THE BEHAVIOR OF MIGRATING FISH

A. G. Poddubnyy *In its* Bionics 20 Apr. 1966 p 323–332 refs (See N66-24126 13-04) CFSTI: $9.10

Return of fish to their original environment, following natural migratory movements or man-made displacements, is investigated; and it is found that a majority of fish move with the direction of the magnetic meridian. This occurs more frequently in situations where there are more homogeneous hydrophysical indices. Temperature, electrical conductivity, and depth as possible orientation factors are considered interrelated; and the speed of movement appears to be seasonal and related to time of day. Study of the navigational accommodations of fish is concluded to be of great value for the simulation of navigational engineering systems.

M.W.R.

N66-24167# Joint Publications Research Service, Washington, D. C.

THE LATERAL LINE OF FISH AS A DEVICE FOR PERCEPTION OF THE ELECTRICAL FIELD

N. V. Bodrova and B. V. Krayukhin *In its* Bionics 20 Apr. 1966 p 333–340 refs (See N66-24126 13-04) CFSTI: $9.10

To determine the role of receptor in the surface of the body of fish to perceive electrical currents, the fish were anesthetized with novacaine to exclude the sensory nerves in their terminal apparatuses. It was found that carp and bullheads so anesthetized decreased their sensitivity by between 25 and 50%. It is concluded that the nerve endings of the body surface are stimulated by the current, and that fish with more nerve endings in their skin were more sensitive. Receptors in the lateral nerve of bream and pike were innervated for additional experiments, which lowered sensitivity to an electrical current, although thresholds were different for the two kinds

of fish. It is suggested that researchers in bionics might turn their attention to the lateral line of fish as a complex and sensitive device which can perceive electrical and magnetic fields. M.W.R.

N66-24168# Joint Publications Research Service, Washington, D. C.

ON THE PROBLEM OF SOUND GENERATION AND DIRECTIVITY OF SOUNDS IN DOLPHINS

Ye. V. Romanenko, A. G. Tomilin, and B. A. Artemenko *In its* Bionics 20 Apr. 1966 p 341–346 refs (See N66-24126 13-04) CFSTI: $9.10

An experiment was undertaken to determine the role of the head of the white barrel dolphin as a concentrator of sound vibrations in the formation of a radiation pattern. A ceramic barium titanate sphere was mounted in the head of a dead dolphin in the area where the sound bags are located. When the dolphin's head, with emitter and receiver implanted, was submerged in water, it was discovered that a circular pattern of frequencies resulted, and that the radiation pattern became noticeably narrower when the frequencies went from low to high. At 30 kc, the pattern was approximately 90°, at 180 kc, it was 17°. Other studies with dolphins are mentioned. M.W.R.

N66-24169# Joint Publications Research Service, Washington, D. C.

SOME MATERIAL ON INTERPRETATION OF INFORMATION BY LIVING SYSTEMS

G. F. Plekhanov *In its* Bionics 20 Apr. 1966 p 347–352 refs (See N66-24126 13-04) CFSTI: $9.10

On the basis of a study in which examinees developed a conditioned response to change in voltage of an electromagnetic field of high frequency, and from some supporting evidence in the literature, it is concluded that information perceived by man is transmitted by signals of specific intensity and range. Further the specific receptors have force and range thresholds. Man can interpret information transmitted by subthreshold signals; nonspecific receptors, that is any cells, can perceive this subthreshold information; and while this information is transmitted, stored, and processed in the central nervous system, the procedure is not conscientiously recognized by man. In other words, direct stimuli cause a conditioned reflex and certain behavior, but subthreshold stimulation may evidence itself in the variation of certain physiological functions. Reference is made to some experiments with ants. M.W.R.

N66-24170# Joint Publications Research Service, Washington, D. C.

A MAGNETIC FIELD AS A STIMULUS

Yu. A. Kholodov *In its* Bionics 20 Apr. 1966 p 353–366 refs (See N66-24126 13-04) CFSTI: $9.10

Fish, amphibians, birds, and mammals were studied for their orientation to a magnetic field created by a constant cobalt magnet and an electromagnet through which a direct current was passed; in a few experiments, on fish and frogs, a 50-cycle alternating magnetic field was used. Although voltages varied between one and 1000 oersteds, the majority were between 100 and 300 oersteds. In most of the experiments, the magnetic field affected the physiological processes. In general, the magnetic field appears to be a weak stimulus; even in cases where a conditioned reflex was developed to the magnetic field, it was much weaker than reflexes to light or sound. The magnetic field is characterized as having a predominantly inhibiting influence on the central nervous system of vertebrates. Under magnetic field effect, it was found that EEG changed while pulse activity of the neurons remained almost unchanged. It is proposed that the glial cells of the brain are responsible for such results. M.W.R.

N66-24171# Joint Publications Research Service, Washington, D. C.

THE MECHANISM OF SHARPENING THE FREQUENCY SELECTION OF THE HEARING ORGAN

A. P. Molchanov and V. K. Labutin *In its* Bionics 20 Apr. 1966 p 367–376 refs (See N66-24126 13-04) CFSTI: $9.10

A three-channel system to explain the sharpening selectivity of the ear, based on the Licklider and Huggins hypothesis, may insure an increase in the actual selectivity of a model despite the existence of nonlinear elements. Detectors with a good deal of inertia were used to avoid the suppression of a weak signal by a stronger one. Some types of envelope detectors may not be particularly good in cases where there are signal disturbances in the three channel system. A detailed schematic and a block diagram of the three-channel model for sharpening frequency are shown. Each of the three amplifiers in the model has one oscillatory circuit, at the output of which there is a diode detector. Trimmers set the resonance frequencies for each channel, and variable resistors regulate the amplification. To decrease the output resistance of the model circuit, the final cascade is assembled as a follower made of pentodes with high curvature. M.W.R.

N66-24172# Joint Publications Research Service, Washington, D. C.

ON THE ELECTROMAGNETIC HYPOTHESIS OF BIOLOGICAL COMMUNICATION

A. N. Malakhov, A. S. Maksimov, and Yu. Ya. Nefedov *In its* Bionics 20 Apr. 1966 p 377–381 refs (See N66-24126 13-04) CFSTI: $9.10

A review of some experimental studies indicates that the spectrum of bioelectric activity of animals is continuous and drops with an increase in frequency of exposure. It is concluded that this continuity is evidence of the stochastic, noise nature biopotentials; the decrease at high frequencies is considered to indicate that the basic energy of the bioelectric activity resembles ultrasonic frequencies. Investigations further reveal that there are electromagnetic (EM) emissions from certain muscles of the frog, and evidence is presented for a forearm muscle. It is stated, however, that because these emissions are so minute they cannot serve as carriers of information in biocommunications, at least not in frequency ranges up to 150 kc. High frequency emission of a resonance nature may have some possibility for the use of EM emission as the basis for biocommunication. M.W.R.

N66-24173# Joint Publications Research Service, Washington, D. C.

BIOLOGICAL INDICATION OF AN SHF ELECTROMAGNETIC FIELD

A. N. Malakhov, I. V. Romanov, Yu. V. Smirnov, M. Yu. Ul'yanov *In its* Bionics 20 Apr. 1966 p 382–386 refs (See N66-24126 13-04) CFSTI: $9.10

Plerocercoids, fish, and mice are found to have the ability to indicate the existence of super-high frequency (SHF) fields. Plerocercoids subjected to both UHF and SHF irradiation do not survive as long as do those organisms in the control group; however, there are differences in survival rates for various frequencies. A conditioned reflex procedure was then used to determine whether the SHF electromagnetic field can serve as an information carrier for an animal, and experiments with

fish and mice indicate that this is possible. The length of time required to develop these conditioned responses in mice, as well as the instability of the reactions, the short time the stimuli are retained, and their rapid extinguishability are considered to be evidence of the low information value of SHF signals in the vital activity of these white mice. M.W.R.

N66-24174# Joint Publications Research Service, Washington, D. C.

ON THE BIOELECTROMAGNETIC FIELD

M. A. Khvedelidze, S. I. Dumbadze, and T. D. Surguladze *In its* Bionics 20 Apr. 1966 p 387–397 refs (See N66-24126 13-04) CFSTI: $9.10

Although numerous experiments were carried out, there was no confirmation obtained for a proposed bioelectromagnetic field of low frequency accompanying the excitation and contraction of the heart and other muscle in the frog. Analysis of an individual nerve fiber and the whole nerve indicates that the total magnetic flux around both the part and the whole approaches zero. It is concluded that the electromagnetic radiation (EMR) of a living system may be considered as one of the forms of conversion of energy at the molecular level during metabolism; and that this EMR quantum in a living system occurs which is considered a carrier of information and a control signal in the living self-organizing system. M.W.R.

N66-24175# Joint Publications Research Service, Washington, D. C.

BIOLUMINESCENCE AS A SOURCE OF INFORMATION ABOUT BIOLOGICAL PROCESSES

I. I. Gitel'zon, R. I. Chumakova, and A. M. Fish *In its* Bionics 20 Apr. 1966 p 398–408a refs (See N66-24126 13-04) CFSTI: $9.10

A bathyphotometer, with submerged and above water parts joined by a cable, was used to investigate (1) the relationship between bioluminescence in the sea and both underwater optics and the ecology of marine organisms and (2) bioluminescence as a source of information about biological processes. Bathyphotograms were classified with respect to amplitude, length, and shape; used to determine the level of constant light background and the amount the bioluminescent signals exceed it; and to calculate the concentration of light producing objects in the water. Measurements indicate that lighting at nighttime is significantly more intense than during the day; and this may be explained by the physiological diurnal rhythm of the luminescence effect and the vertical migration of the bioluminescence reducing organisms. M.W.R.

N66-24176# Joint Publications Research Service, Washington, D. C.

MORPHOLOGICAL AND FUNCTIONAL BASE OF ACOUSTICAL ORIENTATION IN LAND VERTEBRATES IN CONNECTION WITH PROBLEMS IN SIMULATION

N. P. Naumov, V. D. Il'ichev, G. N. Simkin, and B. D. Vasil'yev *In its* Bionics 20 Apr. 1966 p 409–422 refs (See N66-24126 13-04) CFSTI: $9.10

A literature survey relating to the simulation of acoustical orientation in land vertebrates reveals that there is inadequate zoological data in the following areas: (1) inventory of the basic species and their hearing systems; (2) objects that can be used for more profound simulation investigations; (3) criteria for hearing which will permit the accumulation of morphological, physiological, and ecological data; and (4) combined functional and morphological data for use in bionic applications. The peripheral parts of the ear are considered appropriate as criteria for aural sensitivity; and are of interest because they serve as frequency filters and they can selectively perceive sound. M.W.R.

N66-24177# Joint Publications Research Service, Washington, D. C.

ON THE ROLE OF ECHOLOCATION IN THE ANALYSIS OF SPACE BY BATS

E. Sh. Ayrapet'yants and A. I. Konstantinov *In its* Bionics 20 Apr. 1966 p 423–432 refs (See N66-24126 13-04) CFSTI: $9.10

In studies relating to the flight of bats, it is found that the echo location spatial orientation is realized by means of temporary communications or conditioned reflexes. Destruction of the eardrum membrane results in a temporary disappearance of the straight-line directional path of the bat; movement becomes random and finding food accidental. Rapid restoration of linear motion is restored within 30 to 40 cm of the feedbox, indicating that the eyes play a role after the destruction of the hearing apparatus. Yet, cutting off the vision in bats appears to play an insignificant role in the selection of the correct course to find the feeding box. It is assumed that in returning to the refuge, bats orient themselves either with respect to the magnetic forces of the Earth or some other means which is not known to man rather than by echoes. M.W.R.

N66-24178# Joint Publications Research Service, Washington, D. C.

ON THE ASTRONAVIGATIONAL ABILITY OF MIGRATORY BIRDS

E. V. Kumari *In its* Bionics 20 Apr. 1966 p 433–437 refs (See N66-24126 13-04) CFSTI: $9.10

The literature is reviewed for information relating to the navigational ability of migratory birds, with special attention given to the explanation of orientation which occurs during nighttime migration. The theory that migratory birds make use of the solar azimuth and the stellar sky in finding their course is considered plausible, and further interdisciplinary studies are recommended for its substantiation. M.W.R.

N66-24179# Joint Publications Research Service, Washington, D. C.

EXPERIMENTS IN NEAR ORIENTATION AND THE INDIVIDUAL BEHAVIOR OF BIRDS

K. N. Blagosklonov *In its* Bionics 20 Apr. 1966 p 438–443 refs (See N66-24126 13-04) CFSTI: $9.10

When homing characteristics were studied in several species of birds, it was found that sex played no noticeable role, although females generally returned to the nest somewhat faster than males. Speed of return was not influenced by the number of baby birds in the nest, and the maturity of the nesting birds was not a significant factor. In non-nesting young birds, however, only one of 14 returned to the nest from a distance of 14km. Birds kept in captivity for six hours did not return until nine or 10 hours later, while those encaged for only two hours returned home within three hours. Landscape orientation factors appear to play a role in homing, and there appear to be a great deal of individual differences between various birds in speed of solution as well as the method employed. Reasons given to account for some birds losing their orientation during the nesting period include: (1) orientation

ability, just as migratory instinct, may be seasonal in nature; (2) orientation during homing may involve a different mechanism than orientation in migration; and (3) homing is accomplished alone, whereas migration is a group activity. M.W.R.

N66-24180# Joint Publications Research Service, Washington, D. C.
THE PROBABILITY MECHANISM OF ACQUIRING NAVIGATIONAL SKILLS IN BIRDS DURING MIGRATION
V. E. Yakobi *In its* Bionics 20 Apr. 1966 p 444–451 refs (See N66-24126 13-04) CFSTI: $9.10

Navigational skills of birds, found to be formed before migration, are considered related to near orientation and to post nest wanderings. During these post nest wanderings, birds fly in a direction where feeding, defense, and aerodynamic conditions improve; and flight is connected with displacement of the sun, prevailing wind reaction, and a generally favorable ecological direction. Discontinuity in the process of acquiring navigation experience during migration is supported by the fact that birds do not always take the exact same route to their wintering ground. M.W.R.

N66-24181# Joint Publications Research Service, Washington, D. C.
NAVIGATIONAL CAPABILITIES OF MIGRATORY BIRDS
Kh. A. Mikhel'son and Ya. A. Viksne *In its* Bionics 20 Apr. 1966 p 452–458 refs (See N66-24126 13-04) CFSTI: $9.10

Travel loops formed during migration of birds between nesting and wintering grounds are discussed for the case of the Muscicapa hypoleuca, whose flight is between various parts of the Soviet Union and the Mediterranean area of Spain and Northern Africa. It is noted that the return flight in the spring is by a shorter route than the winter migration. Mature males return to the same or almost the same nesting area as in previous years, whereas the young males do not exhibit this specificity. M.W.R.

N66-24182# Joint Publications Research Service, Washington, D. C.
RESULTS OF HOMING EXPERIMENTS WITH VARIEGATED FLYCATCHERS
Ye. K. Vilks *In its* Bionics 20 Apr. 1966 p 459–461 refs (See N66-24126 13-04) CFSTI: $9.10

When variegated flycatchers were moved from two to three kilometers from their nests, more than 50% did not return. The majority of those who returned required between 10 and 20 hours, and some of the females did not return for two or three days. There appeared to be no significant difference between those females hatching their eggs and those feeding fledglings. These experiments support the assumption that landscape markings have no decisive significance in the return of birds from relatively short distances. It is suggested that these negative results with regard to homing may be explained by the fact that the bird may not realize that he is in a strange place because he is a relatively short distance from his nest as compared to where he goes during migration. It is also suggested some peculiarities in the navigational mechanism do not adapt themselves to short distance homing. M.W.R.

N66-24183# Joint Publications Research Service, Washington, D. C.
ON THE LIMITS OF THE CAPACITY OF SMALL BIRDS FOR ORIENTATION
V. R. Dol'nik and V. A. Payevskiy *In its* Bionics 20 Apr. 1966 p 462–471 refs (See N66-24126 13-04) CFSTI: $9.10

Small birds are found to be capable of determining the coordinates of an area to a very limited extent in a study dealing with sparrows. It was also shown that young finches can measure the length of day to within 10 minutes, and the date for migration to within three days. While these time measurements with respect to fall migration are very accurate, it is concluded that the perfect navigation of birds during their natural migration is explainable not by accurate determination of the coordinates in space, but rather by choices made because of influencing conditions during the migration itself. M.W.R.

N66-24184# Joint Publications Research Service, Washington, D. C.
THE FIRST RESULTS OF INVESTIGATIONS OF MIGRATING ORIENTATION IN SPARROWS BY THE ROUND CAGE METHOD
M. Ye. Shumakov *In its* Bionics 20 Apr. 1966 p 472–480 refs (See N66-24126 13-04) CFSTI: $9.10

The circular cage method is considered an excellent way to study the orientation of birds during migratory periods because of the directionalness orientation and the astro-orientation factors applicable to such a method. It is found that directionalness of activity of the birds in the circular cage has a well-expressed diurnal rhythm with a maximum in the morning hours for the daylight migrants and at night for the nocturnal migrants. Further, the nocturnal migrants orient themselves during the daylight hours when there is sun. Seasonal variations in the caged studies correspond to changes which occur under natural conditions. The use of astro-orientation factors in the nonmigration period was not detected for several species of birds. During the migration period, rotation of the cage appears to have no effect on the direction the birds fly. It was also found that most species of birds were not influenced noticeably by flocks of other birds flying by; and in the presence of astro-orientation factors, most birds maintained the direction which is characteristic of their own species. M.W.R.

N66-24185# Joint Publications Research Service, Washington, D. C.
SOME COMMENTS ON THE PROBLEM OF ORIENTATION
N. P. Naumov and V. D. Il'ichev *In its* Bionics 20 Apr. 1966 p 481–483 refs (See N66-24126 13-04) CFSTI: $9.10

A general discussion of orientation in birds mentions the limited capability of birds who are alone, and it is suggested that birds with a large angle of flight cannot orient themselves well in space. Particular attention is given to differences in orientation due to individual variability in structure and characteristics as well as to differences in communities of birds. M.W.R.

N66-24186# Joint Publications Research Service, Washington, D. C.
POSSIBLE INTERACTION OF THE MAGNETIC FIELD AND BIOLOGICAL OBJECTS
B. A. Neyman *In its* Bionics 20 Apr. 1966 p 484–485 refs (See N66-24126 13-04) CFSTI: $9.10

The interaction between biological objects and magnetic field is discussed briefly. Since life goes on despite changes in magnetic field of the Earth, it is suggested that conditioned reflexes in animals are in some way connected to these changes. Efforts to find a so-called physiological clock or organ to measure these changes have not be successful, however. The author suggests that living organisms have an inherent capability to feel changes in magnetic field and, therefore, for orientation. M.W.R.

N66-24187# Joint Publications Research Service, Washington, D. C.

THE BIONIC ASPECTS OF THE MAN-MACHINE RELATIONSHIP

V. V. Parin *In its* Bionics 20 Apr. 1966 p 486–494 (See N66-24126 13-04) CFSTI: $9.10

Bionics, considered to be closely related to cybernetics, is discussed as a separate science which is concerned with problems related to the study of: (1) living information systems on the basis of the nervous system and neuron networks, (2) organs of sense and reception in various living specimens, (3) principles of orientation and navigation in living organisms, and (4) structural peculiarities of living organisms. Within this framework, the bionic aspects are discussed for man-machine systems, pattern recognition simulation, and bioenergetics. Special attention is given to a study on "skin" vision which is shown to exists in sighted school-age children and to the use of biological objects as power sources. M.W.R.

N66-24189# Joint Publications Research Service, Washington, D. C.

THE INTERACTION OF AN ELECTRICAL CURRENT WITH THE BODY OF A MAN AS ONE OF THE RESOURCES OF BIOPHYSICAL INFORMATION

V. Ye. Manoylov *In its* Bionics 20 Apr. 1966 p 500–502 refs (See N66-24126 13-04) CFSTI: $9.10

Body traumata from exposure to low voltages are considered caused by an attention factor and the location on the body of the current-carrying part rather than as a result of fibrillation of the heart muscle. During the investigation of the interaction of the human body and an electrical current, usually between four and eight volts, the presence of body zones of increased electrical conductivity were discovered coincident with zones of lowered electrical stability and increased sensitivity to electrical current. It is suggested that these zones result from a phenomenon similar to innercellular breakdown. Experimental investigations in electrical resistance and threshold values of stimulating currents have shown that the numerical values of these parameters depend upon the proportion of oxygen in the air. M.W.R.

N66-24190# Joint Publications Research Service, Washington, D. C.

SOME EXAMPLES OF AUTOMATIC CONTROL FROM THE HEMODYNAMICS OF THE BRAIN AND CALCIUM METABOLISM IN THE BONES OF THE CRANIUM

M. B. Kopylov *In its* Bionics 20 Apr. 1966 p 503–506 refs (See N66-24126 13-04) CFSTI: $9.10

Three examples of circulation in the brain are described as examples of automatic self-control in a living organism: (1) local thinning of the internal bone membrane in the parietal bone close to the longitudinal commissure; (2) paradoxical forward deflection of the veins in the brain; and (3) direction of blood of equal pressure into the symmetrical hemispheres of the brain by two pairs of carotid and vertebral arteries. Another example of automatic self-regulation which is discussed is the dynamics of the calcium content in the cranium due to changes in intercranial pressure. For the latter the example given deals with changes in rigidity and shape of the bones of the skull during hydrocephalia. M.W.R.

N66-24191# Joint Publications Research Service, Washington, D. C.

SHIFTS IN THE LEVEL OF THE CONSTANT POTENTIAL OF THE CEREBRAL CORTEX AND THEIR FUNCTIONAL SIGNIFICANCE

V. F. Rusinov *In its* Bionics 20 Apr.1966 p 507–516 refs (See N66-24126 13-04) CFSTI: $9.10

Polarization of the cerebral cortex surface of a rabbit, using an anode of weak direct current (one to five mka), causes regular shifts in constant electric potential. Magnitude and direction of the shifted potential depend on the initial level. Polarization of the motor region of the cortex which affects one of the extremities can produce motor reactions in the case of previously indifferent stimulation by light or sound to the same part. The center of excitation caused by the polarization can be easily inhibited by amplifying the direct current acting on the cortex. There is complete curtailment of rhythmic oscillations of electrical activity in the cortex, but the excitation center remembers the rhythm of the pulsating current for many hours. M.W.R.

N66-24192# Joint Publications Research Service, Washington, D. C.

ON THE PROBLEM OF RELIABILITY OF OPERATION OF THE BRAIN OF A DOG UNDER THE EFFECT OF NOXIOUS ELEMENTS

V. A. Lovchikov *In its* Bionics 20 Apr. 1966 p 517–523 refs (See N66-24126 13-04) CFSTI: $9.10

The nerve centers which control conditioned reflexes in the dog exhibit a certain stability following various dosages of chloral hydrate and sodium amytal. While poisoning by toxic doses causes damage to individual nerve fibers of the brain, there are no essential changes in conditioned reflexes. Even with a lethal dose of caffeine, certain compensatory mechanisms operate to permit the conditioned reflex activity. Such investigations are considered in relation to the construction of computational automata which will retain their reliability in spite of defects in their structural elements. Representation of the high efficiency of the brain with low reliability of the individual nerve cells is considered an analogy to the problem in computation devices. Details of experiments with six dogs are presented. M.W.R.

N66-24193# Joint Publications Research Service, Washington, D. C.

CORRELATION ANALYSIS OF THE EEG OF A MAN BOTH IN THE NORMAL CONDITION AND WITH CEREBRAL CENTERS OF DAMAGE

O. M. Grindel', G. N. Boldyreva, and V. M. Andreyevskiy *In its* Bionics 20 Apr. 1966 p 524–537 refs (See N66-24126 13-04) CFSTI: $9.10

A comparison was made of electroencephalograms (EEG) obtained from humans with healthy brain tissue and those with tumors at various sites in the cerebral cortex. Correlation analysis methods were employed in the study, and various autocorrelation and mutual correlation functions are plotted to show differences in healthy and tumorous brain tissue. A significant sinephase nature of the electrical activity of symmetrical points of the cerebral cortex is exhibited by the healthy human at rest. In cases of brain pathology there is an increase in the frequency and regularity of the α-rhythm in regions remote from the site of the tumor. Periodic relationships and a time shift in all rhythm ranges are manifested by mutual correlations of the occipital and frontal regions of the healthy brain, whereas the nature of the function varies with the site in cases of brain tumors. The region of the cortex next to the tumor exhibits a periodic process with complete absence or sharp decrease in the random component, whereas in regions remote to the tumor the random process is retained. M.W.R.

N66-24194# Joint Publications Research Service, Washington, D. C.

STATISTICAL PROCESSING OF LOW-FREQUENCY BIOPOTENTIALS

V. A. Pryanishnikov *In its* Bionics 20 Apr. 1966 p 538–546 refs (See N66-24126 13-04) CFSTI: $9.10

Amplitude analyzers and pulse counters which have been used in nuclear physics researches are found to be applicable to statistical processing of the probability characteristics of various biopotentials within a frequency spectrum from zero to 1000 cycles/minute. Measurement errors are estimated to be less than 1% for one-dimensional distributions and less than 5% for joint distributions. The devices used and their calibrations are described, and various graphs plot functional distribution curves for brain measurements of the rabbit. M.W.R.

N66-24195# Joint Publications Research Service, Washington, D. C.

RECIPROCAL INNERVATION SYSTEM

R. I. Bekker *In its* Bionics 20 Apr. 1966 p 547–557 refs (See N66-24126 13-04) CFSTI: $9.10

Reciprocal innervation is treated as a special case of coordination in higher forms of animal life, and the construction of system which simulates walking processes is based on three assumptions: (1) the approaching excitation changes the state in the nerve cell, (2) excitations which reach the nerve cells from different paths act as one; and (3) secondary centripetal impulses cause alternate states of excitation and quiet in the nerve centers of antagonistic muscles during change reflexes. Reciprocal innervation of two muscles, flexor and extensor, is diagrammed for one, two, and four limbs; and diagrams include a contact neuron and an intermediate neuron. Intermediate as well as contact and integration neurons are proposed as the points of application of the impulses during sudden interference of the upper regions of the brain during spinal control of movements. It is noted that small motor neurons are detected along with the large motor neurons; these are identical in all respects, except that the small neurons are not excited during certain monosynaptic discharge of impulses. This is considered plausible if the small neuron corresponds to a proprioceptor. M.W.R.

N66-24196# Joint Publications Research Service, Washington, D. C.

A GENETIC INFORMATION SYSTEM IN COMPARISON WITH ARTIFICIAL INFORMATION SYSTEMS AND SOME PROBLEMS IN BIONICS

N. N. Zhukov-verezhnikov, I. N. Mayskiy, G. P. Tribulev, V. Ya. Kop'yev, A. P. Pekhov et al *In its* Bionics 20 Apr. 1966 p 558–564 refs (See N66-24126 13-04) CFSTI: $9.10

A genetic-type information system is compared to an artificial information system from the point of view of solving problems in bionics and improving methods for simulating systems. Essential differences between the two types of systems are considered to be the following: (1) In artificial systems, recording is physical in nature, by use of mechanical, magnetic, or electronic devices; natural genetic information systems use chains of polymer molecules or chemical properties. (2) The information and actuating elements are disconnected from the main devices in artificial control systems; in genetic systems, the information elements are inherent to the system. (3) A genetic system is self-copying, and not limited to use of purely physical and external phenomena. (4) Genetic systems are capable of self-improvement and further development by the external and internal environment. Applications of and problems related to genetic systems are discussed in very general terms. M.W.R.

N66-24197# Joint Publications Research Service, Washington, D. C.

THE SIGNIFICANCE OF FLUCTUATION OF THE RHYTHM OF STIMULATIONS TO MAINTAIN THE TONUS OF THE CENTRAL NERVOUS SYSTEM

D. N. Menitskiy, V. A. Lovchikov, N. N. Vasilyevskiy, and G. G. Vartanyan *In its* Bionics 20 Apr. 1966 p 565–573 refs (See N66-24126 13-04) CFSTI: $9.10

This article discusses several investigations in connection with the effect of fluctuating the rhythm of stimulations in maintaining the tonus of the central nervous system. An hypothesis concerning the optimal interaction of the nervous centers is formulated which assumes a penalty for both redundant and insufficient afferentation, more adequately reflects the known representations of the mechanism for maintaining the tonicity of the central nervous system, and agrees with experiments on individual neurons and nerve centers. The hypothesis is also supported by experiments with conditioned reflexes under random reinforcement. The procedure ensures a more uniform arrival of information and does not lead to the development of experimental neurosis (as a result of the unexpected breaking of rhythm), or to experimental sleep (as a result of the monotony of the rhythm). In spite of the usefulness of rhythm or stimulation stereotype in the activity of the nervous system and the occurrence of stereotypes among the multiple effects of the external environment, the presence of rigid and uniform stereotypes leads to a lowering of the tonicity of the nervous system. R.N.A.

N66-24198# Joint Publications Research Service, Washington, D. C.

THE ROLE OF SYNCHRONIZATION OF SHIFTS OF THE SOMATIC AND VEGETATIVE FUNCTIONS IN ENSURING RELIABILITY OF PHYSICAL OPERATIONS IN CHILDREN

P. I. Gumener *In its* Bionics 20 Apr. 1966 p 574–585 refs (See N66-24126 13-04) CFSTI: $9.10

This study examined the role of synchronizing shifts of the somatic and vegetative functions to ensure the reliable physical operations of children. The study showed that regulating the physiological functions in children during rhythmic labor motions may manifest itself in slow oscillations of the level of vegetative and motor functions. This control is worsened by limiting the free condition of the work. Controlling the interrelation of vegetative and motor functions determines good synchronization not of individual motions with individual heart beats or respiratory movements, but synchronization of the shift of the average level of the given function. Ensuring the reliability of the work effect requiring relative stability of the corresponding forces may be combined with activity waves reflecting significant oscillations not only of the vegetative functions but also of the determinant motor parameters. Under these conditions reliability of the work effect is promoted by a different condition for controlling the oscillations of these two groups of parameters: the compensation control condition for the first, and the programmed control condition for the second. R.N.A.

N66-24199# Joint Publications Research Service, Washington, D. C.

ILLNESS AS A PROCESS OF EMERGENCY CONTROL IN A LIVING ORGANISM

Ye. V. Gubler *In its* Bionics 20 Apr. 1966 p 586–589 (See N66-24126 13-04) CFSTI: $9.10

This paper discusses illness as a process of emergency control in a living organism. The purpose of this control is self-preservation and self-restoration of the organism. The

role of this control is examined in relation to its effect upon physiological control which maintains the functions of an organism within certain limits. During illness the emergency control takes over and exceeds these limits. For example, during illness the body temperature is increased, pain occurs, the nervous activity is inhibited, and the functioning of certain organs is strengthened. The emergency control is also evidenced in such physiological reactions as regeneration, healing, and immunity; complex behavioral acts such as increased circulation and breathing rates, and hormone excretion; reflex reactions; fainting; and infectious diseases. R.N.A.

N66-24200# Joint Publications Research Service, Washington, D. C.

THE DYNAMICS OF CONTROL OF WATER METABOLISM AND THE CONDITIONS OF CONVERSION OF IT INTO THE AUTOOSCILLATORY CONDITION IN BEAN PLANTS

V. G. Karmanov and V. N. Savin *In its* Bionics 20 Apr. 1966 p 590–596 refs (See N66-24126 13-04) CFSTI: $9.10

The dynamics of water exchange in plants growing in soil under optimal moisture conditions were investigated and compared to plants which have survived the influence of soil dryness. It was determined that when growing under conditions of sufficient moisture, plants exhibit a clear diurnal course of transpiration and regulate their own physiological state comparatively quickly and smoothly in response to a sharp change in the external environment. Cessations of both transpiration and water motion were observed in plants that were subjected to dry soil conditions. After watering and complete restoration of their turgor, these plants reacted to the removal of light or watering by a change in the intensity of the water volume, and by a transition to an oscillatory nature. This oscillatory nature of the watering exchange in plants under invariant conditions of the external environment was considered to be an autooscillatory process. An analogy is then drawn between the oscillations in plants and the autooscillations in any technical system. H.S.W.

N66-24219# Picker X-ray Corp., Cleveland, Ohio.

INDUSTRIAL ANALYSIS OF PROMETHIUM-147 X-RAYS FOR RADIOGRAPHY AND IMAGING READOUT

E. W. Coleman, T. C. Furnas, J. Ball, M. R. Rosumny, and D. W. Beard *In* ORNL Proc. of Symp. on Low-Energy X-ray Sources and Gamma Sources and Appl. Nov. 1965 p 222–230 (See N66-24206 13-24) CFSTI: HC $4.00/MF $1.75

In experiments with a 100-Ci ^{147}Pm source on radiography and fluoroscopy of medical phantoms and of various metal step wedges with standard penetrameters, exposure times required generally were excessively long. Studies of the spectral output and use of the source to excite secondary spectra, which were evaluated with a scintillation detector and 400-channel pulse height analyzer, demonstrated interesting capabilies on sorting materials. A third series of experiments was on determination of the effective focal spot size and relating this to theoretical excitation conditions in the source. Author (NSA)

N66-24221# Johns Hopkins Univ., Baltimore, Md.

MEDICAL APPLICATIONS OF LOW-ENERGY X-RAY AND GAMMA RADIATION SOURCES

Henry N. Wagner, Jr. *In* ORNL Proc. of Symp. on Low-Energy X-ray Sources and Gamma Sources and Appl. Nov. 1965 p239–242 ref (See N66-24206 13-24) CFSTI: HC $4.00/MF $1.75

Experiments using a nuclear image amplifier with ^{133}Xe and ^{99m}Tc for measuring blood flow and respiration are described briefly. Initial results were found to be promising. NSA

N66-24222# Harvard Univ., Cambridge, Mass. School of Dental Medicine.

USE OF IODINE-125 FOR INTRAORAL X RADIOGRAPHY

Rune Söremark *In* ORNL Proc. of Symp. on Low-Energy X-ray Sources and Gamma Sources and Appl. Nov. 1965 p 243–256 refs (See N66-24206 13-24) CFSTI: HC $4.00/MF $1.75

The use of ^{125}I as an X-ray source for dental radiography is described. It is pointed out that ^{125}I can be concentrated to a very small focus and thus it is possible to have a rather short distance between the source and object. Exposure time may be reduced without impairing the quality of the roentgenograms and various types of exchangeable collimators may be used in order to diminish unsuitable radiation. Ordinary intraoral roentgenograms can easily be taken by means of a simple film-source holder fixed to the teeth. For panoramic roentgenograms the unit is small enough to be placed intraorally in a holder and collimator fixed to the teeth. The collimator is so constructed that an exposure of the upper and/or lower jaws may be made on the extra-orally placed film. As opposed to the conventional dental X-ray apparatus, the ^{125}I unit requires a minimum of space, is easy to transport, and is entirely independent of electrical power. A fast and high resolution Polaroid film eliminates the need for dark room facilities. Exposure data relating to various human objects are included. NSA

N66-24223# Chicago Univ., Ill. Dept. of Radiology.

RADIOISOTOPIC DEVICE FOR MEASURING BONE MINERAL

Lawrance H. Lanzl and Nels Strandjord *In* ORNL Proc. of Symp. on Low-Energy X-ray Sources and Gamma Sources and Appl. Nov. 1965 p 257–276 refs (See N66-24206 13-24) CFSTI: HC $4.00/MF $1.75

An instrument using radioactive ^{125}I was devised for nondestructive determination of mineral changes in the skeleton by measuring the transmission of a small beam of radiation emanating from ^{125}I through a single human finger bone. For small animals, the rear leg is used. Radiographs must be used for accurately positioning the anatomical part under consideration. Built into the unit are an automatic repositioning feature and an automatic print-out device. The absorption coefficients of bone in vivo can be determined to an accuracy of ±1%. The apparatus is being used to study osteoporosis in post-menopausal females, including the effect of stilbesterol in decreasing osteoporosis, and demineralization in experimental animals. Author (NSA)

N66-24224# Wisconsin Univ., Madison.

BODY COMPOSITION DETERMINATION BY DIFFERENTIAL ABSORPTION OF MONOCHROMATIC X-RAYS

James A. Sorenson and J. R. Cameron *In* ORNL Proc. of Symp. on Low-Energy X-ray Sources and Gamma Sources and Appl. Nov. 1965 p 277–289 refs (See N66-24206 13-24) CFSTI: HC $4.00/MF $1.75

The technique of determining the fractional composition of a two-component system by X-ray beam attenuation measurements was studied. The method was tested on sodium acetate–polyethylene mixtures of known compositions and was applied to samples of animal muscle and fat. The results were within 3% of other independent determinations. Statistical errors and the problems of nonmonochromatic X-ray

sources and scattered radiation were also examined. It was concluded that the technique is an accurate method for quantitative determination of the composition of the mixtures studied. Author (NSA)

N66-24225 Argonne National Lab., Ill.
IN VIVO MEASUREMENT OF BONE MINERAL CONTENT BY A TRANSMISSION TECHNIQUE
Leonard S. Goodman and Bertram Levin (Michael Reese Hosp.) *In* ORNL Proc. of Symp. on Low-Energy X-ray Sources and Gamma Sources and Appl. Nov. 1965 p 290–294 refs (See N66-24206 13-24) CFSTI: HC $4.00/MF $1.75

A preliminary investigation of a method for in vivo determination of bone mineral content is presented. Linear transverse scans of transmission are made across a bone for two different monoenergetic X-rays. The information so obtained can be reduced to give the $Ca_3(PO_4)_2$ equivalent per centimeter of bone. The transmission scan also yields an effective diameter of the bone. Division of the equivalent amount of tricalcium phosphate by the diameter yields an index of mineral content which has less scatter from individual to individual than the amount alone. Author (NSA)

N66-24227# Viso Corp., Detroit, Mich.
PORTABLE DEVICES FOR ISOTOPE CHEST RADIOGRAPHY AND OTHER APPLICATIONS
Farno L. Green *In* ORNL Proc. of Symp. on Low-Energy X-ray Sources and Gamma Sources and Appl. Nov. 1965 p 309–328 refs (See N66-24206 13-24) CFSTI: HC $4.00/MF $1.75

Ytterbium 169 was found to be the best isotope source now available for medical diagnostic radiography. Ytterbium sources were used for general diagnosis in a lightweight system with a tripod-mounted radiographic exposure unit and X-ray film cassettes. The Viso chest radiography system is easily transported into essentially any populated area, assembled in minutes, and operated without electrical power. Only minor maintenance is required. Such systems also allow very low dose to the patient and to the operator.
Author (NSA)

N66-24305# Joint Publications Research Service, Washington, D. C.
ACUTE RADIATION ILLNESS AND DOSAGE DETERMINATION
N. A. Kurshakov, ed. 12 Apr. 1966 42 p Transl. into ENGLISH from the book "Ostraya Radiatsionnaya Travma u cheloveka" Moscow, 1965 p 3, 5–45
(JPRS-35011; TT-66-31449) CFSTI: $2.00

CONTENTS:

1. THE PATHOGENESIS AND GENERAL CLINICAL CHARACTERISTICS OF ACUTE RADIATION ILLNESS N. A. Kurshakov p 2–24
2. DETERMINATION OF ABSORBED DOSES R. D. Drutman, M. S. Malysheva and Yu. M. Shtukkenberg p 25–35

N66-24345# RAND Corp., Santa Monica, Calif.
COMPUTER STUDIES OF RESPIRATION
T. W. Murphy May 1965 75 p refs
(Grants NIH GM-09608-04; NIH GH-09608-03; NIH HE-08186-03)
(RM-4406-NIH; AD-615635) CFSTI: HC $3.00/MF $0.75

An approach to respiratory studies is described which utilizes modern data-processing (computing) equipment. The calibration of the rather complex system is described. The abilities of the device are demonstrated in an investigation of the tidal volume-dead space relationship. Advantages of this approach are discussed. Author (TAB)

N66-24439# Joint Publications Research Service, Washington, D. C.
SELECTIONS FROM NEUROHUMORAL MECHANISMS OF RETICULAR FORMATION OF THE BRAIN STEM
R. Yu. Il'yuchenok 6 Apr. 1966 44 p Transl. into ENGLISH from the book "Neyro-Gumoral'nyye Mekhanizmy Retikulyarnoy Formatsii Stvola Mozga" Moscow, 1965 p 197–215, 216–222
(JPRS-34906; TT-66-31344) CFSTI: $2.00

Several experiments were conducted to study the question of chemical sensitivity of nerve elements in brain stem reticular formation, and to assess the various theories concerning the mechanism of the ascending activation system. The question of whether the activation effect of catecholamines and adrenomimetics is a result of the direct action of these drugs on the neurons of brain stem reticular formation, or is connected with blood circulation changes, was also considered. Animal experiments, using a variety of drugs, are described, and the findings are assessed. Data regarding the dependence of the degree of EEG changes on the rate of dose administrations are reported, along with findings on the influence of pharmacological substances on the mechanisms of the arousal reaction. The inhibitory action of serotonin is also assessed. Several techniques used in studying the neurohumoral mechanisms of the brain stem reticular formation are summarized. M.G.J.

N66-24449# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS FROM *GIGIYENA I SANITARIYA* (HYGIENE AND SANITATION), MOSCOW, NO. 12, 1965
22 Mar. 1966 25 p refs Transl. into ENGLISH of five articles from Gigiyena i Sanit. (Moscow), no. 12, 1965 p 50–51, 54–57, 98–102
(JPRS-34665; TT-66-31104) CFSTI: $1.00

CONTENTS:

1. QUICK DETERMINATION OF NOXIOUS ADMIXTURES IN THE AIR BY MEANS OF REAGENT PAPER G. A. Parsadanyan p 1–2 refs
2. VITAL STAINING OF TISSUES IN THE DETERMINATION OF STANDARDS OF ATMOSPHERIC POLLUTION A. I. Kopanev p 3–8 refs
3. JOINT MEETING OF ALL-RUSSIAN SOCIETY OF HYGIENISTS, RESEARCH INSTITUTE OF HYGIENE IMENI F. F. ERISMAN, AND SOCIETY OF CARDIOLOGISTS L. I. Maksimova p 9–10
4. READERS' CONFERENCE ON WORK OF GIGIYENA I SANITARIYA V. F. Katsitadze p 11–12
5. DATA ON NATURAL POPULATION MOVEMENT IN THE USSR Z. G. Frenkel' and T. S. Soboleva p 13–18

N66-24461# School of Aerospace Medicine, Brooks AFB, Tex.
GLUCOSE TOLERANCE RESPONSES IN YOUNG ADULTS OF SHARPLY CONTRASTING PERIODONTAL STATUS
Final Report, Feb. 1963–Apr. 1964

Ira L. Shannon, Timothy J. O'Leary, William A. Gibson, and Robert L. Jenson Feb. 1966 13 p refs
(SAM-TR-66-9; AD-629741) CFSTI: HC $1.60/MF $0.50

Conventional oral glucose tolerance tests were performed for 100 systemically healthy young adult males. Half of these subjects were classified as being relatively free of periodontal involvement (GPI=1.60), while the other half presented evidence of loss of alveolar support and, in general, could be classified as requiring periodontal treatment (GPI=3.15). Statistical analyses sought differences in glucose responses between the two groups at all sampling intervals. No significant differences were found. These results confirm previous observations from this laboratory that glucose tolerance testing cannot be employed as an index of susceptibility of periodontal involvement in this age group. Author (TAB)

N66-24473# Federal Aviation Agency, Oklahoma City, Okla.
INTRARENAL HEMODYNAMIC CHANGES FOLLOWING ACUTE PARTIAL RENAL ARTERIAL OCCLUSION
Charles M. Brake, Dale Reins, Lorenz E. Wittmers, and Lerner B. Hinshaw Oct. 1965 10 p refs
(AM-65-27)

Both an increase and a decrease in total renal vascular resistance, following a period of total renal artery occulsion, have been reported from this laboratory. The duration of the occlusive period and height of the perfusion pressure were found to prescribe consistently the hemodynamic response. The present study, using adult mongrel dogs, indicates that, following a period of partial occlusion, in a critical range of renal pressure (40% to 50% of control), intrarenal hemodynamic changes mimicked those seen after total obstruction of blood flow. Reactive hyperemia was not observed. Author

N66-24493*# Florida State Univ., Tallahassee. Dept. of Statistics.
VARIATION IN MEASUREMENTS OF MICROBIAL LOADS
Richard G. Cornell 16 Feb. 1966 11 p /t Tech. Rept.-2
(Grant NGR-10-004-029)
(NASA-CR-74549) CFSTI: HC $1.00/MF $0.50 CSCL 06M

Distribution of microbial load measurements based on bioassays are investigated to see if the maximum tolerance is exceeded. A measurement model is used which determines the mean load for the population from which the item being tested is taken. Consideration is given to variations involved in these measurements, such as variation (1) from one item to another of the same type and (2) in microbial density over the surface and interior of an item. An assay procedure is proposed to determine the probability that a microorganism will contaminate a spacecraft component, and the necessary equations are included. M.W.R.

N66-24667 Joint Publications Research Service, Washington, D. C.
STUDIES IN LABOR HYGIENE AND OCCUPATIONAL DISEASES
A. K. Gus'kova et al 6 Apr. 1966 35 p refs Transl. into ENGLISH of four articles from Gigiyena Truda i Prof. Zabolevaniya (Moscow), no. 1, Jan. 1966
(JPRS-34928; TT-66-31366) CFSTI: $2.00

CONTENTS:

1. WORKING CONDITIONS AND HEALTH STATUS OF WORKERS AT THE UNITED INSTITUTE OF NUCLEAR RESEARCH A. K. Gus'kova, A. I. Ponizovskaya, Ye. A. Denisova, V. V. Volkovitskaya, Ye. N. L'vovskaya et al p 1–9 refs

2. THE RESULTS OF DYNAMIC OBSERVATIONS OF THE STATE OF HEMOPOIESIS IN PERSONS SUBJECTED TO THE CHRONIC EFFECT OF IONIZING RADIATION V. V. Sokolov and I. A. Gribova p 10–16 refs

3. THE VALUE OF A BRIGHT WORKING SURFACE Yu. D. Khilov p 17–21 refs

4. THE DEVELOPMENT AND COURSE OF SILICOSIS AFTER CESSATION OF CONTACT WITH DUST V. N. Palkin p 22–28 refs

N66-24690*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
STERILIZATION—A SELECTED BIBLIOGRAPHY FROM THE LITERATURE RETRIEVAL SYSTEM, SPACE BIOLOGY BRANCH
Mar. 1966 25 p refs
(NASA-TM-X-55457; X-450-66-53) CFSTI: HC $1.00/MF $0.50 CSCL 06F

An annotated bibliography is presented with topical headings. These headings include: (1) clean rooms; (2) decontamination; (3) sterilization methods, i.e., air filtering, chemicals, and heat; (4) methods and statistics for detection and monitoring of microorganisms; (5) spacecraft sterilization; and (6) survival, i.e., viability of microorganisms. D.T.

N66-24694*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
A QUANTAL INTERPRETATION OF SENSORY CHANNEL UNCERTAINTY AND REACTION TIME AND THE PSYCHOLOGICAL TIME QUANTUM AND THE DISCRIMINATION OF SUCCESSION
Alfred B. Kristofferson Washington, NASA, May 1966 39 p refs
(Contract NAS2-2486)
(NASA-CR-455) CFSTI: HC $2.00/MF $0.50 CSCL 05J

A quantal concept of psychophysiological time is defined in quantitatively precise terms. The behavioral routes into the concept are given as: the main parameter of a quantal model of the variability of reaction time; time difference between independent signals necessary for 100% detection of succession; and the increment added to reaction time by channel uncertainty. The quantities are discussed, and experimental results are tabulated. Results suggest that zero to one temporal quantum is consumed in switching attention between sensory channels when conditions are optimal. The principal evidence further shows that the three quantities are equal in magnitude, highly correlated over individuals, and the same for different sensory channels. N.E.N.

N66-24699# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
REVIEW OF COMPENDIUM "INFLUENCE OF IONIZING RADIATION ON THE FUNCTIONING OF THE HIGHER SECTIONS OF THE CENTRAL NERVOUS SYSTEM OF OFFSPRING"
N. L. Livshits 28 Sep. 1965 9 p Transl. into ENGLISH from Patol. Fiziol. i Eksperim. Terapiya (Moscow), v. 7, no. 3, 1963 p 90–91
(FTD-TT-65-860/1+4; TT-65-64182; AD-622457) CFSTI: HC $1.00/MF $0.50

Several articles are reviewed in which investigations of the radiosensitivity of the central nervous system during ontogenesis are reported. Female rats, mice, and other rodents were irradiated with X- and gamma-rays at various times during pregnancy. The functioning of reflexes and the ability of the

progeny to learn and perform complicated tasks were tested. In all cases, the animals exhibited reduced sensitivity to stimuli, and a reduced ability to learn. D.T.

N66-24706# Library of Congress, Washington, D. C. Aerospace Technology Div.
CBE FACTORS Monthly Survey No. 1
[1966] 71 p refs
(ATD-66-4; AD-628294) CFSTI: HC $3.00/MF $0.75

The report is a survey by a team of analysts covering the following areas: Chemical factors: Pesticides; Herbicides; Fertilizers; Psychotomimetics; Other chemicals. Biological factors: Pathogens. Environmental factors: Aerosols: Ecology; Micrometeorology; Soil Science. This combined report, the first of a series of monthly surveys, includes items selected for catch-up purposes, as well as current materials. The proportion of current material will tend to increase in future reports. TAB

N66-24714# Goteborg Univ. (Sweden). Dept. of Histology.
RESEARCH ON INTRA NEURONAL MECHANISMS FOR INFORMATION STORAGE Technical Report No. 1
Holger Hyden 31 Mar. 1965 52 p refs
(Grant AF-EOAR-63-28)
(AFOSR-66-0364; AD-628899) CFSTI: HC $3.00/MF $0.50

Different types of micro-chemical methods used for analysis of neurons and glia are discussed. As an introduction to a discussion of a biochemical response in neuron and glia during learning, a few basic problems are mentioned and some pertinent results are given. The neurons are especially rich in RNA and during a life-cycle in man, there can be discerned a rise, steady level and fall in the RNA content of moto-neurons. What this cycle of changes means from a functional point of view, seems to be an important problem to consider for future studies. During sleep-wakefulness, rhythmic enzyme changes were recorded alternating between the neurons and glia in the caudal part of the reticular formation in rabbits. These changes are taken to reflect circadian, rhythmic processes underlying the biological clock phenomenon. During physiological stimulation of the nervous system in mammals, an increase of the RNA content, total proteins and enzyme activities have been found in the neurons, and a decrease in the surrounding glia. To elucidate this phenomenon, a kinetic study and other experiments were carried out. The results showed that the neuron and its glia are coupled as a unit from an energetic point of view. Some RNA data from a study of Parkinson's disease are given to show that one part of the unit can influence the other from a biochemical as well as from a functional point of view.
Author (TAB)

N66-24722# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRON MICROSCOPY METHOD OF INVESTIGATION OF BIOLOGICAL OBJECTS
V. I. Biryuzova, V. L. Borovyagin, V. P. Gilev, N. A. Kiselev, A. S. Tikhonenko et al 13 Apr. 1965 250 p refs Transl. into ENGLISH of the book "Elektronnomikroskopicheskiye Metody Issledovaniya Biologicheskikh Ob'yektov" Moscow, Izd. Akad. Nauk SSSR, 1963 p 1-203
(FTD-MT-64-149; TT-65-63947; AD-621062) CFSTI: HC $4.00/MF $1.25

Basic methods of investigating biological objects are outlined. Special features of biological preparations which impart characteristic features to the process of preparing specimens are examined. Methods of contrasting with the help of shadowing, dyeing with salts of heavy metals, and also the method of negative contrasting are examined in detail. Various means of preparing replicas are described. The questions of fixation and dehydration of objects and the methodology of preparing ultrathin sections are examined in detail. Some practical problems of working with the electron microscope and questions of photographic technique are outlined briefly. Author (TAB)

N66-24758# Joint Publications Research Service, Washington, D.C.
SOME MEDICAL CONCLUSIONS FROM THE VOSKHOD-2 SPACE WALK
Ye. Karpov 14 Apr. 1966 10 p Transl. into ENGLISH from Krasnaya Zvezda (Moscow), 18 Mar. 1966 p 4
(JPRS-35054; TT-66-31492) CFSTI: $1.00

Medical conclusions from the Voskhod-2 space walk flight are discussed. An account of the biomechanical and medical training of the flight crew is given. Emotional tension was noted in both astronauts; but the emotional intensity in general was moderate and did not greatly affect the activity of the crew. On opening the hatch of the exiting lock and on entering open space, the astronaut's pulse grew rapidly to 150-152 per minute. It is concluded that more complex and prolonged manned flights in outer space are possible from the medical and biological points of view.
L.S.

N66-24767# Naval Air Development Center, Johnsville, Pa.
PSYCHOPHYSICAL METHODOLOGY II: COMPARISON OF MEANS AND OF STANDARD DEVIATIONS OF THE ASCENDING AND DESCENDING METHOD OF LIMITS
Robert M. Herrick 31 Dec. 1965 17 p refs
(NADC-MR-6508; AD-628995) CFSTI: HC $1.60/MF $0.50

Assume that the probability of a 'yes' response increases as the stimulus intensity increases. Then, on the basis of probability considerations alone (a) the mean threshold of the descending method of limits (DML) is greater than the mean threshold of the ascending method of limits (AML) and (b) sigma of the DML threshold distribution may be greater than, equal to, or less than sigma of the AML threshold distribution. Therefore, (a) the present method for evaluating errors of expectation and habituation is erroneous, (b) the 'just not noticeable difference' (JNND) should always be larger than the 'just noticeable difference' (JND), (c) conclusions about relative precision based on a comparison of sigmas are wrong. Author (TAB)

N66-24783# Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.
AN INVESTIGATION OF VISION DURING INVOLUNTARY SACCADIC EYE MOVEMENTS
Robert W. Ebbers (M.S. Thesis—Indiana Univ.) Feb. 1966 42 p refs
(ARL-TR-66-4; AD-629078) CFSTI: HC $2.00/MF $0.50

The purpose of the investigation reported here was to determine whether or not vision is present during involuntary saccades. The results indicate that vision is present, though impaired, during the involuntary saccades. Evidence is also presented which indicates that an intensity threshold factor is involved. Further, it is strongly suggested that the visual impairment is due to a blue or smear of the retinal image. TAB

N66-24820# Monsanto Research Corp., Everett, Mass.
EFFECTS OF SELECTED STRAINS OF MICROORGANISMS ON THE COMPOSITION OF FUELS AND LUBRICANTS Final Report, 1 Sep. 1962–27 Nov. 1964
Glenn R. Wilson, John O. Smith, H. F. Martin, Dolph Klein, E. C. Harrington et al Wright-Patterson AFB, Ohio, Res. and Technol. Div., Jan. 1966 154 p refs
(Contract AF 33(657)-9814)
(RTO-TDR-63-4117, Pt. II; MRB-2023F, AD-628673)

A select number of aerobic bacterial and fungal cultures (isolates from contaminated fuel tank bottoms) were screened against a variety of jet fuels (JP-4 and JP-6), a lubricant, a liquid rocket propellant, and a spectrum of pure hydrocarbons (naphthenes and normal and branched alkanes) for growth-supporting properties. Variable growth support on all jet fuel samples was noted with the exception of one which was found to contain no detectable normal alkanes. Removal of normal alkanes from the other jet fuel samples significantly reduced their growth-supporting properties. The normal alkanes supported the most growth, the 2-methyl and 2,2-dimethyl alkanes lesser growth, and the naphthenes no growth support. After the prolonged incubation of several of the bacterial cultures on the initially resistant jet fuel sample, several cultures adapted to it. A variety of jet fuel additives were also screened against bacterial cultures and certain types were found to inhibit growth. Author (TAB)

N66-24825# Harry Diamond Labs., Washington, D. C.
PROPOSED SPECIFICATION FOR AN ARTIFICIAL HEART TO BE IMPLANTED IN THE CHEST
Kennety E. Woodward 13 Jan. 1965 44 p refs
(HDL-TM-65-32; AD-619673) CFSTI: HC $2.00/MF $0.50

The proposed specification sets forth some of the requirements for an artificial heart to be implanted in the chest. Functional requirements of output pressures and flows and venous pressure and load responses are described. The hemolytic limitations believed to be adequate for indefinite pumping are stated together with the general requirements for packaging to meet the unique environment imposed on the heart. A statistical acceptance technique is proposed for determining the life and reliability of the heart prior to implantation. Feasibility of achieving certain of the proposed requirements is illustrated by experiences gained during the developing of an extracorporeal blood pump called the Army Artificial Heart Pump. The functional validity of the specification is further demonstrated by a prototype fluid-amplifier controlled artificial heart designed according to the requirements set forth herein and implanted in calves.
Author (TAB)

N66-24837# Joint Publications Research Service, Washington, D. C.
TECHNIQUE EMPLOYED IN IRRADIATING EXPERIMENTAL ANIMALS
R. E. Novikova 2 May 1966 14 p refs Transl. into ENGLISH from Med. Radiol. (Moscow), v. 11, no. 1, Jan. 1966 p 88–93
(JPRS-35286; TT-66-31723) CFSTI: $1.00

This article describes methods and apparatus used in irradiating experimental animals to insure the standardization of physical conditions during irradiation, the environmental moisture surrounding the irradiated animal, and methods for determining spatial distribution of radiation and of the biological material. R.N.A.

N66-24842*# Miami Univ., Coral Gables, Fla. Inst. of Molecular Evolution.
THE TERRESTRIAL ORIGINS OF MACROMOLECULES AND OF CELLS
Sidney W. Fox [1965] 41 p refs Presented at the Colloq. on Elementary Biol. Systems and Abiogenesis, Paris, 24–25 Nov. 1965 *Its* Contrib. No. 056
(Grants NsG-173-62; NsG-689)
(NASA-CR-74819) CFSTI: HC $2.00/MF $0.50 CSCL 06A

This article describes molecular evolution studies concerned with the origin of biopolymers in the absence of cells and the chemist, and the spontaneous conversion of the polyamino acid type of such polymers into cells. Experiments are discussed which show how moderately controlled heating of alpha-amino acids, either in the laboratory or in the geological matrix, can yield a polymer which, by simple contact with water, will easily organize itself into a minimal kind of membranous cell having catalytic, fissile, and other activities imitating those of a true biological unit. At the interpretative level, these findings indicate some of the particular internally limited ways in which the now recognized and vexing biochemical and cytological complexity could begin to arise by simple processes. Experimental studies since 1959 have demonstrated how abiotic matter can organize itself into a cell if that matter is also of the appropriate origin and molecular structure. R.N.A.

N66-24854# Bureau of Ships, Washington, D. C.
DIAGNOSIS AND THERAPY OF CAISSON DISEASE [SENSUI-BYO NO SHINRYO (DAI 2 HO)] Report No. 2
Kiyohide Hida, Kakutaro Niida, and Kenji Hori Nov. 1965 26 p Transl. into ENGLISH from Kyosai Iho (Tokyo), v. 13, no. 4, Nov. 1964 p 21–28 *Its* Transl. No.-942
(AD-476124)

Clinical case histories of patients suffering from decompression sickness are presented. The cases include patients with one and a half to 32 years experience, and from 22 to 54 years old. The disease occurred most at 30–40 m diving depth and with three or more dives. The therapy takes into consideration the old Japanese Navy therapy charts, symptoms and other conditions. It was concluded that the most successful treatment is the recompression tank, and it recommended that the helmet not be removed before the treatment. At present two methods are being used: (1) lengthening as long as possible the period of low compression during decompression and (2) providing enough oxygen inhalation. N.E.N.

N66-24908*# National Aeronautics and Space Administration, Washington, D. C.
ELECTROCARDIOGRAPHY
H. C. Burger Dec. 1965 195 p Transl. into ENGLISH of the book "De Electrische Werking van Het Hart" 1963
(NASA-TT-F-9772) CFSTI: HC $5.00/MF $1.25 CSCL 06E

A survey of the state-of-the-art of electrocardiography is presented. The heart from the point of view of anatomy is discussed. In addition to electrocardiography, vectorcardiography, a variant on the classic concept, is considered in more detail. The instrumentation, techniques, representations, and clinical applications are covered. N.E.N.

N66-24915*# National Aeronautics and Space Administration, Washington, D. C.
USE OF INTERFERENTIAL CURRENTS IN COMBINED ANAESTHESIA IN SURGERY [PRIMENENIYE INTERFERENTSIONNYKH TOKOV V KOMBINIROVANNOM OBEZBOLIVANII PRI KHIRURGICHESKIKH OPERATSIYAKH]

M. I. Kuzin, V. D. Zaukovskiy, and V. I. Sachkov Apr. 1966 14 p refs Transl. into ENGLISH from Russian
(NASA-TT-F-10090) CFSTI: HC $1.00/MF $0.50 CSCL 06E

A method of combined electroanaesthesia, used in a number of surgical operations, with interferential currents is described. In order to choose the correct current for anaesthesia (minimal interferential currents bring light anaesthesia) the patient analgesia was determined before the operation. It is pointed out that when interferential currents are used the clinical shortcomings of the method are eliminated. D.T.

N66-24920*# National Aeronautics and Space Administration, Washington, D. C.
ON THE CONSTRUCTION OF A MATHEMATICAL MODEL OF A "BIOLOGICAL CLOCK" [KPOSTROYENIYU MATEMATICHESKOY MODELI "BIOLOGICHESKIKH CHASOV"]
B. S. Moshkov, L. Ya. Fukshanskiy, and G. I. Yuzefovich Apr. 1966 12 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 167, no. 2, 1966 p 440–443
(NASA-TT-F-10107) CFSTI: HC $1.00/MF $0.50 CSCL 06P

A mathematical model of the biological clock, with analogs in living tissue and applicable to lower and higher forms of life, is described. Changes in the diurnal rhythm produced by variations in the period and type of illumination of various spectral regions are computed, based on a one-to-one correspondence of spectral composition of the radiation and time rate of change in the concentration of metabolic substances. Results show that the biological clock has a period with a frequency stability of 99% almost independent of temperature; the rhythm is excited by red and white light and damped by infrared irradiation; the diurnal rhythm is kept constant under periodic illumination of a 24-hour period, changed basically by application of light with a period differing from 24 hours, and canceled by continuous illumination. Author

N66-24922*# National Aeronautics and Space Administration, Washington, D. C.
ECOLOGICAL AND GEOGRAPHICAL VARIABILITY OF SOIL BACTERIA
Ye. N. Mishustin Feb. 1966 312 p refs Transl. into ENGLISH of the book "Ekologo-Geograficheskaya Izmenchivost' Pochvennykh Bakteriy" Moscow, Izd. AN SSR, 1947
(NASA-TT-F-10124) CFSTI: HC $7.00/MF $1.75 CSCL 06M

Basic aspects of soil microbiology from the viewpoint of geographical ecology are reviewed, with emphasis on various subspecies of B.mycoides isolated from Russian soils of differing type (chernozem, podzol, gray soil, steppe soil, etc.) and differing geographical location. Darwin's laws for higher organisms are extended to microorganisms by proving the existence of ecological types of bacteria, regularly succeeding each other on progressing from North to South. Use of typical bacteria as indicator organisms for soil-forming processes in various climates and for determining the origin of grain and other seed material is discussed. Extensive tabular material on optimum and maximum temperature for various bacteria species, nutrient media, fermentative power for sugars, cell widths, spore size, thermal death point, etc. and photomicrographs of growth stages are included. Author

N66-24923*# National Aeronautics and Space Administration, Washington, D. C.
CONTRIBUTIONS TO THE PHYSIOLOGY OF WATER AND SODIUM CHLORIDE [BEITRAGE ZUR PHYSIOLOGIE DES WASSERS UND DES KOCHSALZES]
Otto Cohnheim, and G. Kreglinger May 1966 26 p refs Transl. into ENGLISH from Z. Physiol. Chem. (West Berlin), v. 63, 1910 p 413–431
(NASA-TT-F-10131) CFSTI: HC $2.00/MF $0.50 CSCL 06P

Results of experiments on the water and sodium chloride metebolism in human subjects, under altitude and lowland conditions, at rest and under physical exertion, are discussed, with tabulated data on excretion and retention of chlorine. Increased muscular work at high altitudes (4600 m) led to a transient hydremia, without change in hemoglobin concentration. Profuse perspiration resulted in chlorine depletion, compensated later by increased chlorine retention. Reduction in the HCl content of the gastric juice was observed. Author

N66-24944*# Naval School of Aviation Medicine, Pensacola, Fla.
SEA URCHIN MITOSIS IN HIGH MAGNETIC FIELDS
Vernon R. Reno 1 Feb. 1966 26 p refs *Its* Rept.-9
(NASA Order R-39)
(NASA-CR-74592; NAMI-954) CFSTI: HC $2.00/MF $0.50 CSCL 06F

Mitosis in sea urchin eggs was retarded following their exposure to magnetic fields higher than 70,000 gauss which had gradients greater than 4200 gauss/centimeter. The degree of retardation was correlated simultaneously to both the field strength and the field gradient. Division in fields ranging from 100,000 to a maximum of 120,000 gauss was independent of the gradient. Differences in division delay were found which may be a reflection of the differential migration of oxygen and nitrogen due to their para- and diamagnetic properties. A hypothesis is given concerning the biochemical processes affected by magnetic fields. Author

N66-24950*# Pennsylvania State Univ., University Park. Dept. of Biophysics.
PHYSICS OF CELLULAR SYNTHESIS, GROWTH AND DIVISION Progress Report, 1 Oct. 1965–31 Mar. 1966
Ernest C. Pollard 26 Apr. 1966 12 p refs
(Grant NsG-324)
(NASA-CR-74755) CFSTI: HC $1.00/MF $0.50 CSCL 06R

Work concerned with the synthesis, growth, division, structure, and function of the bacterial cell is reported. In studies of the nature of the effect of an irradiated medium on cells, recent work suggests that hydrogen peroxide is generated in the medium which interferes with aerobic metabolism by reducing the ATP supply in the cell thus depleting the amino acid pool, and resulting in a shutdown of translation. In studies utilizing localized damage as a tool for elucidating the cell structure and function, fast proton bombardment experiments revealed both a fast and a slow component in DNA degradation. Other work regarding localized mutations resulting from uracil-5-H^3 decay in Escherichia coli; amino acids; and physical chemical studies are also discussed briefly. L.S.

N66-24967*# Naval School of Aviation Medicine, Pensacola, Fla.
THE THOUSAND AVIATOR STUDY: DISTRIBUTIONS AND INTERCORRELATIONS OF SELECTED VARIABLES
Albert Oberman, Norman E. Lane, Robert E. Mitchell, and Ashton Graybiel 1 Sep. 1965 221 p refs Joint Rept. with Public Health Serv. and NASA *Its* Monograph 12
(NASA Order R-136)
(NASA-CR-74710) CFSTI: HC $6.00/MF $1.25 CSCL 06N

This report describes in detail the distribution and intercorrelations of 100 variables selected from the measures obtained during the 1963 follow-up examination in the Pensacola thousand aviator study. During the 1963 examination, a large body of physiological, psychological, and personal

history data was collected on 675 surviving members of the original population. Because of the magnitude and diversity of this information, an over-all view of distributions and interrelationships was necessary for (1) providing assistance in understanding the findings of the study, and (2) indicating possible areas of further research by facilitating the discovery of relationships not otherwise apparent. Data are presented in the form of descriptive statistics, frequency histograms, and Pearson correlation coefficients. Comments deal exclusively with statistical considerations, and no interpretations are attempted. C.T.C.

N66-24988*# Public Health Service, Cincinnati, Ohio. Robert A. Taft Sanitary Engineering Center.
ECOLOGY AND THERMAL INACTIVATION OF MICROBES IN AND ON INTERPLANETARY SPACE VEHICLE COMPONENTS Fourth Quarterly Progress Report, Jan. 1–Mar. 31, 1966
Robert Angelotti Apr. 1966 26 p ref
(NASA Order R-36-015-001)
(NASA-CR-74711) CFSTI: HC $2.00/MF $0.50 CSCL 06M

The thermal resistance of *Bacillus globigii* spores dried on paper strips and encapsulated in Lucite rods has been determined at a dry heat exposure temperature of 125°C. The $D_{125°C}$ value for these spores dried on paper strips was found to be 1.72 hours with a 95% confidence interval of 1.61 to 1.83 hours. In duplicate experiments performed with these spores encapsulated in Lucite, the $D_{125°C}$ values were: experiment 1, 3.08 hours, 95% confidence interval of 2.55 to 3.61 hours; experiment 2, 3.44 hours, 95% confidence interval of 2.98 to 3.89 hours. Author

N66-24991*# California Univ., Los Angeles. Space Biology Lab.
ANALYSIS OF BASELINE AND GEMINI FLIGHT GT-7 EEG DATA WITH SPECIFICATION OF ON-LINE COMPUTING REQUIREMENTS
W. R. Adey, R. T. Kado, and D. O. Walter [1965] 37 p refs
(Grant NsG-505)
(NASA-CR-74716) CFSTI: HC $2.00/MF $0.50 CSCL 06B

Evidence has been presented, from analysis of EEG data from a population of 50 astronaut candidates, of common characteristics that clearly separate a gamut of conscious and sleeping states, including concomitants of vigilance and decision-making tasks. Extensive digital computing methods for spectral analysis were used, with display techniques that are suited to medical monitoring. Computer recognition of these states by discriminant analysis has indicated the feasibility of on-line computation by special purpose flight computer, using minimal numbers of data channels, and as few as 4 variables in each channel. The essential requirements are discussed for on-line computation and display. Application of these techniques to EEG data from Gemini Flight GT-7 are discussed. The analyses emphasize the value of the EEG in detection of both slow and rapid shifts in states of sleep and wakefulness beyond levels that can be detected by observations of EKG and/or respiration. Author

N66-25084# Sandia Corp., Albuquerque, N. Mex.
HEALTH HAZARDS FROM SELENIUM RECTIFIERS
John P. Grillo [1964] 13 p refs Presented at the Rocky Mountain Sec., Am. Ind. Hygiene Assoc. Meeting, Albuquerque, N. Mex.
(Contract AT(29-1)-789)
(SC-DC-65-1790; CONF-651037-1) CFSTI: HC $1.00/MF $0.50

Hazards from selenium fume as a result of rectifier arc-over are discussed and data and specific examples are included. Methods for determining the amount of selenium exposure in the event of accidents are suggested. NSA

N66-25116# Institute for Cancer Research, Philadelphia, Pa.
STUDIES OF THE EFFECTS OF ULTRAVIOLET RADIATION ON CELL STRUCTURE AND BEHAVIOR Annual Progress Report, Nov. 1964–Nov. 1965
Jerome J. Freed 20 Dec. 1965 28 p refs
(Contract AT(30-1)-2356)
(TID-22493) CFSTI: HC $2.00/MF $0.50

Motile activity of cultured cells was studied with special emphasis on the saltatory motion of cytoplasmic organelles. The results suggest the presence of a system of microtubules distributed throughout the cell cytoplasm, in connection with which rapid particle movements take place. At the same time, uv cytophotometric analyses of living cells were continued, using the vibrating mirror flying spot microscope to measure changes in absorbancy during normal interphase growth and to follow the kinetics of absorbancy decrease after actinomycin blockade of RNA synthesis. The effects on cell multiplication and behavior of a protein fraction from differentiated cells were tested; these proteins are believed to play a role in dye-induced carcinogenesis, and had been postulated to have a repressor-like activity. The experiments demonstrated the inhibitory nature of this protein fraction. Genetic studies of haploid frog cells, resulted in development of a satisfactory cloning technique and other procedures required for isolation of mutants. Author (NSA)

N66-25147# Naval Medical Research Inst., Bethesda, Md.
SUMMARIES OF RESEARCH
D. Minard et al 1964 41 p refs

A summary of the research activities for the year 1964 is presented. Included are abstracts/or summaries of research reports in the areas of: Environmental Stresses, Nutritional Biochemistry, Biophysics, Chemistry, Experimental Surgery, Molecular Energetics, Physical Biochemistry, Protozoology, Parasitology, Intracellular Microbiology, Pathobiology, Medical Entomology, Helminthology, Behavioral Sciences, and Dental Research. H.S.W.

N66-25161# Joint Publications Research Service, Washington, D. C.
PHYSIOLOGICAL RESEARCH
I. M. Alekseyeva et al 26 Apr. 1966 27 p refs Transl. into ENGLISH from Fiziol. Zh. (Kiev), v. 12, no. 1, Jan.–Feb. 1966 p 56–68
(JPRS-35187; TT-66-31624) CFSTI: HC $1.00

CONTENTS:

1. EFFECT OF TRANSFUSION OF THE PROTEIN BLOOD SUBSTITUTE BK-8 ON THE PROTEIN COMPOSITION OF THE BLOOD SERUM IN OLD ANIMALS I. M. Alekseyeva p 1–11 refs

2. CHANGE IN THE BIOPHYSICAL PARAMETERS OF THE PROTOPLASM'S SURFACE LAYER OF MOLLUSC NEUTRONS INDUCED BY IONIZING RADIATION V. I. Bogomolets and V. A. Mayskiy p 12–21 refs

N66-25155# Aeronautical Center, Oklahoma City, Okla. Office of Aviation Medicine.
PHASE SHIFTS OF THE HUMAN CIRCADIAN SYSTEM AND PERFORMANCE DEFICIT DURING THE PERIODS OF TRANSITION: I. EAST-WEST FLIGHT

G. T. Hauty and T. Adams Dec. 1965 19 p refs
(AM-65-28)

At periodic intervals throughout the biological day, biomedical assessments were made for a week prior to jet flight to Manila, for 8 days of layover at Manila, and for a week following return. The rapid translocation effected primary phase shifts as follows: for rectal temperature and heart rate, 4 days; for palmar evaporative water loss, 8 days. The return flight effected a 1-day phase shift. Behavioral integrity was degraded, although to a lesser extent after return. Duration of behavioral impairment was much shorter than the lag time of physiological phase shifts. Author

N66-25202# Joint Publications Research Service, Washington, D. C.

SOVIET HYPODYNAMIA EXPERIMENT

Levon Agayan, Igor Grigor'yev, Toriy Mashkevich, and Konstantin Nikitenko 28 Dec. 1965 21 p Transl. into ENGLISH from Znaniye Sila (Moscow), no. 10, Oct. 1965 p 6-9
(JPRS-33504; TT-65-34078) CFSTI: $1.00

A description is given of a hypodynamia experiment which was conducted in a simulated 10-day space mission. This includes descriptions of the internal sensations of the experimenters and all the conditions under which the experiment was conducted. Preliminary conclusions are that motor coordination was disturbed, and that there was a partial drop in muscular strength, endurance, and mental and physical efficiency. The relationships of morphologic structures in the organism were influenced; the muscular mass decreased somewhat and there was a noticeable increase of fatty tissue. C.T.C.

N66-25205# Joint Publications Research Service, Washington, D. C.

APPLICATION OF PHILOSOPHY TO BIOLOGY AND GAME THEORY

26 Apr. 1966 41 p refs Transl. into ENGLISH from Vopr. Filosofii (Moscow), no. 1, 1966 p 65-74, 148-150, 93-103
(JPRS-35191; TT-66-31628) CFSTI: $2.00

CONTENTS:

1. PHILOSOPHICAL PROBLEMS OF MOLECULAR BIOLOGY R. S. Karpinskaya p 1-14 refs
2. CONFERENCE ON PHILOSOPHICAL PROBLEMS OF CONTEMPORARY BIOLOGY V. P. Chekurin p 15-19
3. SOME METHODOLOGICAL PROBLEMS OF GAME THEORY N. N. Vorob'yev p 20-34 refs

N66-25223# Battelle-Northwest, Richland, Wash.

HANFORD BIOLOGY RESEARCH Annual Report No. 14, 1964

R. C. Thompson and S. W. Woods, ed. Jan. 1965 268 p refs
(Contract AT(45-1)-1830)
(BNWL-122) CFSTI: HC $6.00/MF $1.25

Biological research activities concerned with radioelements are reported. Radioelement toxicity, metabolism, deposition, and response were investigated, along with studies in animal, cellular, and plant physiology, and ecology. Chronic and biological effects of inhaled $Pu^{239}O_2$, Sr^{90}, I^{131}, Ce^{144}-Pr^{144}, Ru^{107}-Rh^{106}, Cs^{137}, Pm^{147}, Zn^{65}, Np^{237}, and other radioelements on various animals, and the biological effects of these elements on the animal organs were studied. Other work is discussed regarding bile salt absorption from an irradiated rat intestine; the influence of fission neutrons on rat reproduction; DDT toxicity in flour beetles; the synthesis of RNA in Escherichia coli; the role of indole pyruvic acid in the metabolism of trytophan in Neurospora; the incorporation of Acetate-1-C^{14} into long-chain fatty acids by lung Mitochondria; the absorption and translocation of Rb^+ and I^- by intact plants; and the effects of moisture and air temperature on deposition and retention of I_2^{131} on plants and soil. Other research activities regarding ecological systems are also discussed. L.S.

N66-25232# California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology.

INTERCEPTION AND RETENTION OF RADIOACTIVE FALLOUT BY DESERT SHRUBS IN THE SEDAN FALLOUT FIELD Final Report

William E. Martin 10 Dec. 1965 47 p refs
(Contract AT(04-1)-GEN-12; Proj. Sedan)
(PNE-238F) CFSTI: HC $2.00/MF $0.50

Concentrations of ^{131}I and ^{89}Sr on plants contaminated by fallout from Project Sedan tended to decrease with increasing distance from ground zero and increasing time after the detonation. Microscopic and radiometric examinations of foilage indicated that most of the activity deposited on leaves was probably due to particles $<5\ \mu$ in diameter. A comparison between the theoretical and observed interrelations of gamma dose rates, ^{131}I and ^{89}Sr deposition rates, and ^{131}I and ^{89}Sr interception by desert shrubs indicated a deficiency of ^{131}I relative to ^{89}Sr in areas more than 40 miles from ground zero and an excess of both ^{131}I and ^{89}Sr relative to dose rates in areas about 100 miles from ground zero. Statistical analyses indicated that the frequency distributions of variates representing maximum concentrations of ^{131}I and ^{89}Sr on plants, and in the tissues of rabbits collected at the same times and locations in the fallout field, were not normal but lognormal. Similar analyses indicated that the frequency distributions of effective half life estimates could be treated as either normal or lognormal. NSA

N66-25302# Joint Publications Research Service, Washington, D.C.

PHYSIOLOGICAL, ACOUSTIC, AND CARDIAC STUDIES BASED ON COSMONAUT EXPERIENCE

2 May 1966 65 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 1, Jan.-Feb. 1966 p 3-35
(JPRS-35278; TT-66-31715) CFSTI: $3.00

Several Soviet studies in aerospace medicine and biology are presented. They include physiological responses of cosmonauts in support-free space, problems in developing an optimum acoustic environment in spacecraft cabins, changes in the cardiac activity and respiration of cosmonauts during the orbital flight of Voskhod 1, and vestibular reaction of the deaf upon exposure to angular and coriolis accelerations. R.N.A.

N66-25306*# National Aeronautics and Space Administration, Washington, D. C.

AEROSPACE MEDICINE AND BIOLOGY—A CONTINUING BIBLIOGRAPHY, MARCH 1966

Apr. 1966 143 p refs
(NASA-SP-7011(23)) CFSTI: HC $4.00/MF $1.00 CSCL 06

An annotated bibliography is presented on aerospace medicine and biology. The subject coverage concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the earth's atmosphere or in interplanetary space. Also included are references describing similar effects on biological organisms of lower order, and related topics such as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors. R.N.A.

N66-25317# Joint Publications Research Service, Washington, D. C.
STUDIES IN MENTAL TELEPATHY
Leonid Leonidovich Vasil'yev 12 May 1966 148 p refs Transl. into ENGLISH of the book "Vnusheniye Na Rasstoyanii (Zametki Fiziologa)" Moscow, Gospolitizdat., 1962 p 1-160
(JPRS-35467; TT-66-31903) CFSTI: $4.00

CONTENTS:

1. HISTORY OF THE MATTER AND BASIC CONCEPTS p 3-14 refs
2. CASES FROM DAILY LIFE CONSIDERED AS SUGGESTIONS AT A DISTANCE p 15-26 refs
3. EXPERIMENTAL ESTABLISHMENT OF SUGGESTION AT A DISTANCE p 27-40 refs
4. A COMPARISON BETWEEN CASES IN LIFE AND EXPERIMENTAL RESULTS p 41-46 refs
5. LOOKING FOR BEST EXPERIMENTAL CONDITIONS p 47-59 refs
6. TELEPATHIC COMMUNICATION p 60-67 refs
7. THE GIFT OF TELEPATHY p 68-80 refs
8. THE PHYSIOLOGICAL STUDY OF SUGGESTIONS AT A DISTANCE p 81-94 refs
9. THE PHENOMENON OF "BIOLOGICAL TELECOMMUNICATION" IN ANIMALS p 95-103 refs
10. THE ELECTROMAGNETIC HYPOTHESIS OF SUGGESTION AT A DISTANCE p 104-117 refs
11. EXPERIMENTS AT A VERY GREAT DISTANCE p 118-129 refs
12. THEORETICAL SIGNIFICANCE AND POSSIBLE PRACTICAL APPLICATION p 130-141 refs

N66-25341# Institute of Cancer Research. Royal Cancer Hospital, London (England). Chester Beatty Research Inst.
TISSUE THERAPY AFTER IRRADIATION
P. C. Koller [1964] 11 p refs
(Contracts IAEA-103/3/US); AT(30-1)-2702)
(TID-21799) CFSTI: HC $1.00/MF $0.50

Progress is reported in studies of the effects of radiation dose and the injection of various types and numbers of hematopoietic cells on recovery of mice from doses of 300, 500, and 700 R x radiation; a comparison of methods of preserving hematopoietic cells; the effects of removal of the thymus on immune reactions in irradiated mice; the effects of irradiation on pre-existing immunity in mice; the effectiveness of thymus grafts in restoring immunological competence to neonatally thymectomized mice; and the effects of thymus grafts on the life span of irradiated mice injected with foreign bone marrow. A list is included of 18 publications during the period covered by this report. NSA

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N66-23928*# Washington Univ., Seattle. Psychophysics Lab.
STUDIES OF THE CONSTANT ERROR
Don A. Ronken and Eugene Galanter 1 Nov. 1965 41 p refs Sponsored in part by NASA
(Contract Nonr-477(34))
(NASA-CR-74695; PLR-14N; AD-629678) CFSTI: HC $2.00/MF $0.50 CSCL 05J

A series of experiments are reported in which attempts are made to study the role of stimulus variables that may affect the magnitude of the constant error. The results indicate that in addition to bias effects that cannot rightly be ascribed to the stimulus, there are certain forms of potential sequential biases that may or may not be stimulus induced. The classical experiment to investigate the phenomenon is redesigned, and some preliminary results are presented to show that the technique is feasible. Author (TAB)

N66-23933# Washington Univ., Seattle. Psychophysics Lab.
ON THE INADEQUACIES OF A LIMITED-STATE THEORY OF THE THRESHOLD
Moncrieff H. Smith, Jr. [1965] 19 p refs
(Contract Nonr-477(34))
(PLR-15N; AD-629679) CFSTI: HC $1.60/MF $0.50

A three-state model of detection, based very closely on Luce's two state model, has been proposed and examined in the context of the psychophysical experiment. Although most of the data used to test the model are of doubtful relevance, being of the confidence-judgment variety, they do serve to warn of the possibility of individual differences between subjects. Some subjects may shift from one attitude to another by a change in pure response bias. For most subjects, however, including one run under appropriate conditions, the data did not support the model. Author (TAB)

N66-23979# George Washington Univ., Washington, D. C. Human Resources Research Office.
MEASURES OF ABILITY AND PROGRAMED INSTRUCTION PERFORMANCE
William H. Melching Dec. 1965 18 p refs
(Contract DA-44-188-ARO-2)
(TR-65-12; AD-629443) CFSTI: HC $1.60/MF $0.50

The results of several programed instruction studies were compared with regard to the relationship between measures of ability and measures of programed instruction performance. Although there were some exceptions, each ability measure tended to be substantially related to each measure of programtest performance. The contention that programed instruction eliminates achievement differences due to intellectual ability was not substantiated. Author

N66-23993# Washington Univ., Seattle.
A NOTE ON SOME ALTERNATIVE MODELS FOR RESPONSE BIAS CHANGES DURING FORCED-CHOICE DETECTION EXPERIMENTS
Don A. Ronken 1 Nov. 1965 13 p refs
(Contract Nonr-477(34))
(PLR-13N; AD-629677) CFSTI: HC $1.60/MF $0.50

Several variants of a learning model for forced-choice detection experiments may be produced by making various reasonable assumptions regarding which events are effective in producing response bias changes. Atkinson and Kinchla assumed the bias changed according to a single parameter stochastic learning mechanism, such changes occurring only when no signal was detected. An alternative formulation uses two learning parameters and postulates the bias changes on every trial, but at different rates, according to whether or not the signal is detected. This two-parameter bias model was applied to the original data, and produced numerical estimates of the parameters which confirm the conjecture that the bias changes principally during non-detection trials. In addition, the parameter estimates indicate that the relative effectiveness of information feedback is determined by its relative frequency of occurrence, an interpretation which was not possible from the single-parameter model. Author

N66-24060# Aerojet-General Corp., Dayton, Ohio.
PROCEEDINGS OF THE CONFERENCE ON ATMOSPHERIC CONTAMINATION IN CONFINED SPACES
Wright-Patterson AFB, Ohio, AMRL [1965] 324 p refs Conf. held at Dayton, Ohio, 30 Mar.–1 Apr. 1965 Sponsored by AMRL
(Contract AF 33(657)-11305)
(AMRL-TR-65-230; AD-629622) CFSTI: HC $7.00/MF $1.50

Conference papers on continuous inhalation exposure techniques, statistical methods of evaluation and interpretation of exposure data, minimum criteria for continuous exposure studies, and toxicological qualification of space cabin materials are presented. For individual titles see N66-24061–N66-24080.

N66-24061# Aerospace Medical Div. Aeromedical Research Lab. (6570th), Wright-Patterson AFB, Ohio.
CHAMBER EQUIPMENT DESIGN CONSIDERATIONS FOR ALTITUDE EXPOSURES
Anthony A. Thomas *In* Aerojet-Gen. Corp. Proc. of the Conf. on Atmospheric Contamination in Confined Spaces [1965] p 9–17 (See N66-24060 13-05) CFSTI: HC $7.00/MF $1.50

Dome shaped altitude exposure chambers for performing inhalation studies are described that operate under controlled conditions of oxygen–CO_2 concentration, oxygen flow rate, temperature, contaminant flow, and absolute pressure and dew point; their altitude capability goes up to 28,000 feet. The flow diagram for this animal exposure chamber encompasses a gas-off oven for heating space cabin materials to their working temperatures, and an additional life support system to maintain the small animal exposure chamber within the 5 psia, 100% oxygen atmospheric parameter. G.G.

N66-24062# Aerojet-General Corp., Dayton, Ohio. Toxic Hazards Research Unit.
CONTAMINANT GENERATION METHODS AND TECHNIQUES
J. D. Mac Ewen *In its* Proc. of the Conf. on Atmospheric Contamination in Confined Spaces [1965] p 18–26 refs (See N66-24060 13-05) CFSTI: HC $7.00/MF $1.50

Contaminant generating techniques are described that introduce into experimental environmental chambers toxic compounds or materials at desired consistency, and gas-off products of material mixtures in the presence of 100% oxygen under pressure, metering, and flow control. A theoretical approach for establishing nominal atmospheric concentrations in an animal exposure chamber uses the formula ppm = mg/l X24, 450Xmol. wt to calculate the amount of gas or other material to be delivered and mixed with the chamber's air stream. Non-volatile liquid agents are introduced into the chamber by atomizers or fog generating devices; aerosols can be generated from suspensions or salt solutions. G.G.

N66-24063# Aerojet-General Corp., Dayton, Ohio. Toxic Hazards Research Unit.
ANALYTICAL CONTROL OF CONTAMINANT CONCENTRATION IN EXPOSURE CHAMBERS
Edmond H. Vernot *In its* Proc. of the Conf. on Atmospheric Contamination in Confined Spaces [1965] p 27–33 refs (See N66-24060 13-05) CFSTI: HC $7.00/MF $1.50

Spectrophotometric and gas chromatographic techniques for controlling low concentrations of contaminants in exposure chambers were described. Air samples were obtained by pumping the gas at low pressure into a glass sampling tube whose volume was measured exactly. Nitrogen dioxide analysis was then performed according to the Saltzman method; carbon tetrachloride and chlorobromethane were quantitatively analyzed by gas chromatographic methods. G.G.

N66-24075# Public Health Service, Washington, D. C. Abatement Branch.
THE FEDERAL CLEAN AIR ACT FOR DOWN-TO-EARTH POLLUTION CONTROL IN UNCONFINED SPACES
Pope A. Lawrence *In* Aerojet-Gen. Corp. Proc. of the Conf. on Atmospheric Contamination in Confined Spaces [1965] p 219–225 (See N66-24060 13-05) CFSTI: HC $7.00/MF $1.50

Highlights of the current federal air pollution control programs were presented and some works under the provisions of the Clean Air Act are outlined. Developments of air quality criteria by establishing standards for source emissions and ambient air are concentrated on the oxides of sulfur and photochemical oxidants such as ozone, but other pollutants are scheduled for intensive study. G.G.

N66-24078# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
PROBLEMS OF SPACECRAFT MATERIALS SELECTION AND TOXICOLOGICAL EVALUATION
Elliott S. Harris *In* Aerojet-Gen. Corp. Proc. of the Conf. on Atmospheric Contamination in Confined Spaces [1965] p 231–241 refs (See N66-24060 13-05) CFSTI: HC $7.00/MF $1.50

Components, materials, and techniques used in various enclosed life support systems which may decrease or add to the contamination problem, are discussed. The general areas involving storing and processing of waste products are defined for the Gemini capsule, the Apollo Command Module, and the Lunar Excursion Module; their individual acceptability criteria for the off-gassing products from non-metallic materials are presented. The following factors developed for minimizing the risk of a toxic response from the spacecraft's crew: (1) off-gassing substances should be low molecular weight additives and unpolymerized materials with relatively high vapor pressures; (2) anticipated leak rates of approximately 0.2 lb/hr at 70°F and 5 psia pressure should be provided; (3) removal and absorption of atmospheric contaminants by activated charcoal and LiOH in the environmental control system; (4) isolation or removal of as many components as possible from the crew compartment; and (5) off-gassing of the space vehicle with all systems operational during preflight decompression tests, thus reducing the quantity of material available for atmospheric contamination. G.G.

N66-24077# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
LIFE SUPPORT EQUIPMENT AND ITS CONTRIBUTION TO CONTAMINANT GENERATION AND REMOVAL
Robert W. Roundy *In* Aerojet-Gen. Corp. Proc. of the Conf. on Atmospheric Contamination in Confined Spaces [1965] p 242–247 refs (See N66-24060 13-05) CFSTI: HC $7.00/MF $1.50

Systems for storing and processing of waste products in a closed atmosphere require antifoaming agents, ion exchange resins, various oxidizing agents, etc., which may contribute to atmospheric contamination. Maintenance of a habitable atmospheres involves the continuous removal of gas from the enclosed environment, the processing of this gas, and the return of the usable portion of the gas for breathing purposes. This process can be accomplished either by cyclic absorption of water vapor and carbon dioxide on molecular sieves, silica gel, activated charcoal, etc., or by a reversible absorption system employing carbon dioxide decomposition techniques to obtain carbon and oxygen. Both processes involve some leakage that must be taken into consideration by the life support designer. G.G.

N66-24078# School of Aerospace Medicine, Brooks AFB, Tex. Chemistry Support Section.

SAMPLING AND ANALYSIS OF ATMOSPHERIC CONTAMINANTS

James P. Conkle *In* Aerojet-Gen. Corp. Proc. of the Conf. on Atmospheric Contamination in Confined Spaces [1965] p 248–267 refs (See N66-24060 13-05) CFSTI: HC $7.00/MF $1.50

Detection and quantitation of contaminants in closed ecological systems rests on techniques for obtaining samples with sufficient concentrations of contaminants to permit analysis. A multistage cryogenic trapping system was developed that passes the sample gas from which the contaminants are to be removed through cylinders maintained at three different temperatures of 0°C, −78°C, and −175°C. This cryogenic trap system partially separates compounds due to the three different operational temperatures in the three traps. Initial infrared examinations and subsequent gas chromatographic studies of the filtered samples, together with the total amount of gas processed by the trapping system and the quantity of the contaminant recovered in the traps, were then used to calculate the mg/m^3 in the simulator atmosphere. G.G.

N66-24079# Monsanto Research Corp., Dayton, Ohio.

ANALYTICAL TECHNIQUES FOR IDENTIFICATION OF GAS-OFF PRODUCTS FROM CABIN MATERIALS

John V. Pustinger *In* Aerojet-Gen. Corp. Proc. of the Conf. on Atmospheric Contamination in Confined Spaces [1965] p 276–295 (See N66-24060 13-05) CFSTI: HC $7.00/MF $1.50

(Contract AF 33(615)-1779)

Several different sampling techniques and analytical methods were used to define gas-off products from a variety of space craft materials, and to estimate the concentration and gas-off rates of these potential contaminants of enclosed atmospheres. Candidate materials were placed for various lengths of times into ecological chambers and the chamber atmospheres were then studied by: (1) analyses of their carbon monoxide and methane content; (2) direct gas chromatography for gas-off products; (3) mass spectrometry of the condensed gas-off products; and (4) gas chromatographic fractionation with mass spectrometric or infrared identification of the collected fractions. Major yields in gas-off products were obtained from candidate paints and coatings; lesser amounts of atmospheric contaminants were released from oxidating, hydrolytic, and sublimating processes. G.G.

N66-24080# Naval Research Lab., Washington, D. C.

ATMOSPHERIC CONTAMINATION IN SEALAB I

Raymond A. Saunders *In* Aerojet-Gen. Corp. Proc. of the Conf. on Atmospheric Contamination in Confined Spaces [1965] p 296–305 (See N66-24060 13-05) CFSTI: HC $7.00/MF $1.50

Contaminants in the atmosphere of an underwater living quarter were sampled by activated charcoal container and recovered from the sampler by slow heating in a vacuum desorption apparatus containing a large bore tube and cryogenic traps for retaining the desorbate. Chromatographic analysis of the desorbate mixture recovered from the charcoal showed some thirty-four peaks. Mass spectral analyses of the fractionated material indicated a total number of approximately one hundred contaminants identified as saturated and unsaturated aliphatic hydrocarbons and aromatic hydrocarbons. The major portion of the desorbate consisted of compounds above C_7 in molecular weight. G.G.

N66-24105# California Univ., Los Angeles. Biotechnology Lab.

UPPER EXTREMITY PROSTHETICS RESEARCH. HUMAN TRACKING, SENSORY MOTOR CONTROL. MYOELECTRIC CONTROL Progress Report, 15 Oct. 1965–15 Jan. 1966

John Lyman 15 Jan. 1966 22 p ref

(Contracts VA-V1005P-9779; N123(60530)32857A; AF 33 (615)-1969; Grant VRA-RD-1201M-64)

(Rept.-66-9; AD-628964) CFSTI: HC $1.00/MF $0.50

Biotechnology research summaries are presented. Upper extremity prosthetics includes investigations of pneumatic and electric limbs, exploration of minor surgical methods for implanting and harnessing transducers, and evaluation of design criteria for externally powered prostheses. Sensory motor control research covers experimental investigations of functional muscle isolation by training, and development of an external logic system for prosthetic motion control. In myoelectric control systems research, investigations of unidimensional EMG control to cyclic and step inputs are reported, and EMG tracking equipment is described. The performance of human operators with tracking systems is discussed. D.T.

N66-24127# Joint Publications Research Service, Washington, D. C.

BIONICS AND ITS SIGNIFICANCE IN TECHNOLOGICAL DEVELOPMENT

A. I. Berg *In its* Bionics 20 Apr. 1966 p 1–9 refs (See N66-24126 13-04) CFSTI: $9.10

The far-reaching implications are discussed for bionics, which is defined as the study applying biological laws to technology to increase the range and quality of technical systems, machines, and instruments. Areas in bionics, related to obtaining, transmitting, and processing information, which are considered include: (1) development of receptors and analyzers for biological systems which have low energy requirements, are highly sensitive and reliable, and are small in size; (2) investigation of neurons for use in all the elements of information handling; (3) consideration of encoding procedures for information transmission within biological systems at various levels; (4) investigation of nerve networks and centers as complex hierarchal systems for handling information; (5) determination of source and nature of pattern recognition processes; construction of control systems related to the adaptation of living organisms to changes in environment; and investigation of means to obtain a high degree of reliability of biological systems. An overview of many of these research areas is presented. M.W.R.

N66-24128# Joint Publications Research Service, Washington, D. C.

PATTERN RECOGNITION IN BIONICS

J. M. Glushkov *In its* Bionics 20 Apr. 1966 p 10–15 refs (See N66-24126 13-04) CFSTI: $9.10

Pattern recognition is considered as one of the most important and complex problems in the area of bionics, and the construction of self-teaching machines is discussed in very general terms. Automatic recognition of patterns is considered closely related to the problem of neuron network simulation; and it is stated that accuracy of such simulation should increase proportionately to progress made in the manufacturing of radioelectronic equipment. In terms of automation theory, the idealized nerve networks are those which are so-called discrete and logical and which can be represented, at least in part, by some continuous set of numerical values. Another

possibility discussed is the simple realization of a homogeneous global mechanism for controlling the average level of activity of the neuron. Limitations to a three-layer perceptron theory of learning are considered, and present trends in perception research are outlined. M.W.R.

N66-24129# Joint Publications Research Service, Washington, D. C.

THE SELECTION OF SIGNS USED IN RECOGNITION

G. Sh. Rozenshteyn *In its* Bionics 20 Apr. 1966 p 16–22 refs (See N66-24126 13-04) CFSTI: $9.10

Reading of letters in pattern recognition problems is approached in terms of the selection of signs for use in the recognition process. It is assumed that a set of operators exists, and that each of the patterns shown may be converted into another pattern by using one of the operators. Although no procedures are as yet available for the determination of such a set, studies are underway which will shed light on the construction of variables which are invariant with respect to the operators. In particular, research in various areas of geometry and topology may be useful in determining patterns in recognition of visual images, and such approaches may be particularly useful in constructing the necessary primary signs. A problem is solved which deals with letters on a random grid line for which certain signs are introduced; and a pattern recognition procedure is proposed which satisfies the six properties which are considered inherent to a shape recognition model and which may be of use in the study of recognition algorithms for animals with primitive visual systems. M.W.R.

N66-24130# Joint Publications Research Service, Washington, D. C.

SOME PROBLEMS IN THE STATISTICAL THEORY OF PATTERN RECOGNITION

A. G. Frantsuz *In its* Bionics 20 Apr. 1966 p 23–35 refs (See N66-24126 13-04) CFSTI: $9.10

A structural diagram is presented for the biological and technical analysis of a pattern recognition dichotomy, that is, the recognition of two classes of patterns. Essentially, this means that two objects from a training series are presented to the system; their descriptions in the form of a set of primary signs are stored in the memory. For the selection of secondary signs, hypotheses which are stored in a library are developed during the recognition solution. It is pointed out that this procedure may not result in the required signs. Statistical interpretation of the results is considered to take place in accord with certain decision rules which are developed during the training process. It is further pointed out that there are at present no means for synthesizing secondary signs from primary ones, although some satisfactory conversions have been developed from intuitive relationships. An object comparison method is considered, and two algorithms which employ statistical probability are investigated for sign selection. Also considered are some assumptions about the normality of the distributions and the equality of the covariance matrices for both classes of objects. M.W.R.

N66-24131# Joint Publications Research Service, Washington, D. C.

NEW DATA ON THE PROCESS OF VISUAL RECOGNITION

V. D. Glezer and A. A. Nevskaya *In its* Bionics 20 Apr. 1966 p 36–45 (See N66-24126 13-04) CFSTI: $9.10

Details are given for a diagram which explains the recognition of shapes by a visual system. The procedure differs from the ordinary tachistoscopic presentation of the image in that erasure of the image switches the visual system to a new problem and interrupts the process of recognition of the first image. It was found that after prolonged training, with sets of four and eight variously-oriented lines, a linear dependency was not observed between amount of information obtained and length of presentation. The concept of carrying capacity is considered inapplicable in such a case, which is regarded as the recognition of a finished pattern by comparison with a stored standard. When recognizing complex figures, there is a direct proportionality between amount of information and time of presentation. It is concluded that certain complex signs are developed by the visual system, but very little about their organization is known. There is evidence, however, that these complex signs are invariant with regard to such changes as magnitude of the image; and, on the basis of some experiments with fish, it is assumed that a complex sign results from the transformation of the image as an entirety. Tests on three humans who were well-trained in the recognition of a specified set of geometric figures indicate that recognition usually takes place via a series of sequential selections with respect to complex signs. M.W.R.

N66-24132# Joint Publications Research Service, Washington, D. C.

CLINICAL PICTURE OF DISTURBANCES IN VISUAL PERCEPTION AND PATTERN RECOGNITION

I. M. Tonkonogiy and I. I. Tsukkerman *In its* Bionics 20 Apr. 1966 p 46–51 refs (See N66-24126 13-04) CFSTI: $9.10

Problems in bionics require new methods for studying the clinical picture of disturbances in visual perception. These methods which are related to theoretical information representations may be of value in clinical diagnosis and rehabilitation therapy for visual impairment. An example of a brain-injured patient is given to show how it is possible to partially compensate for visual disturbance by retention of operative memory of other human systems. Additional study of visual damage will help to determine the volume and internal structure of its operative memory, the delay time for various memory links, and the peculiarities of transferring frequently encountered memory links into long-term memory by statistical encoding during training. Filtration of noises in the analyzer system is discussed, and the use of crossed out figures in pattern recognition is mentioned. M.W.R.

N66-24135# Joint Publications Research Service, Washington, D. C.

THE ROLE OF STABILITY OF THE SPECTRUM IN OBJECTIVE DISCRIMINATION OF VOICE

M. F. Derkach *In its* Bionics 20 Apr. 1966 p 67–74 refs (See N66-24126 13-04) CFSTI: $9.10

An investigation was undertaken to determine frequency ranges in the voice spectrum that can be used to produce an objective classification of sounds according to phonemes, which are considered to be a collection of sounds which are identical with respect to interpretation. For each of the phonemes, determination was made of the average value of the normalized intensity, the intensity dispersion, and the standard error in the average intensity. Data presented on a phoneme consisting of four voiceless consonants and another of three vowels indicate differences in average intensity within each group in a very limited spectral range. The entire group of voiceless glottals differ from the group of vowels in the range of 5700 to 12,000 cycles. It appears that highest values of the stability coefficient correspond to the spectral channels which differentiate between groups of phonemes. M.W.R.

N66-24136# Joint Publications Research Service, Washington, D. C.

FUNCTIONAL ORGANIZATION OF THE NERVOUS SYSTEM AND PATTERN RECOGNITION

R. M. Meshcherskiy *In its* Bionics 20 Apr. 1966 p 75–86 refs (See N66-24126 13-04) CFSTI: $9.10

Feedback in the projection system of a visual analyzer is investigated, and an attempt is made to determine the role of feedback in the pattern recognition process. It is found that an increase in the excitability of the visual cortex produces an increase in amplitude or softening of the response of the geniculate lateral (GL) to a flash of light. A lowering of GL responses accompanies the lowering of visual cortex activity. It is concluded that the projection zone controls the passage of the afferent discharge through the GL by means of both positive and negative feedback. A model is developed to reproduce the interrelationships between the visual cortex and the GL during the course of pattern recognition; circuits in the model determine the associative signs of the pattern and permit comparison of a programed pattern with a combination of excited photodiodes. Data obtained permit a critical approach to the representation of a purely stochastic structure of the central nervous system; and logical networks are presented which simulate certain laws of the functional organization of the so-called visual analyzer. M.W.R.

N66-24137# Joint Publications Research Service, Washington, D. C.

THE DEPENDENCY OF THE SIZE OF THE HUMAN MEMORY ON THE AMOUNT OF INFORMATION

P. B. Nevel'skiy *In its* Bionics 20 Apr. 1966 p 87–92 refs (See N66-24126 13-04) CFSTI: $9.10

Experiments are conducted which indicate that the volume of the human memory is dependent upon the number of symbols remembered as well as the total amount of information. The size of direct memory is considered to reflect the capacity for retaining one time perception, whereas the size of long-term memory reflects both the capacity for retention and the accumulation of information. It is concluded that there are two means of recoding information in the memory process: (1) a decrease in the amount of information in the remembered symbols by limiting the symbol alphabet and not changing the symbols or (2) a decrease in the number of symbols by use of a new alphabet and replacement of symbols by a small number of new symbols. M.W.R.

N66-24138# Joint Publications Research Service, Washington, D. C.

THE STRUCTURE OF THE PROCESS OF MEMORIZING AND INFORMATION PROCESSING BY A HUMAN

P. I. Zinchenko, V. Ya. Lyaudis, and P. B. Nevel'skiy *In its* Bionics 20 Apr. 1966 p 93–97 refs (See N66-24126 13-04) CFSTI: $9.10

Two methods of arbitrary logical remembering, described as processes of indirect memory in its most developed form, are compared. In one method the dependence of memory on the amount of information was investigated; in the other memory was related to amount of information, objective characteristics of the material, and procedures for remembering. Properties of mnemonic conversion of material were studied by the analysis of memory related to unrelated words, subject classification, text material, and number series. A general discussion follows, and the dynamics of mnemonic activity are considered. It is concluded that the amount of information and the length of series determine the size of the memory itself and also in relation to the variation in mnemonic activity of the individual. M.W.R.

N66-24139# Joint Publications Research Service, Washington, D. C.

ADAPTIVE BIOELECTRONIC SYSTEMS OF PERCEPTION, TRAINING AND CONTROL

P. V. Simonov and F. Ye. Temnikov *In its* Bionics 20 Apr. 1966 p 98–106 refs (See N66-24126 13-04) CFSTI: $9.10

Adaptive bioelectronic systems are considered in terms of automatic control of the state of the operator, and mention is made of the use of such adaptive systems in the development of narcosis and automata. Diagrams are shown of an autophotosimulator programed for suppression of alpha rhythm of an electroencephalogram, a bioelectronic attention system, and a device where a change of sequences is automatically controlled by the cutanogalvanic reactions of the observer. Applications for adaptive bioelectronic systems are considered to be in the areas of: (1) perception in man and animals with respect to sensory patterns and generalized signals where emotions come into play; (2) creation of attention-keeping devices which can be used under the influence of such distracting factors as fatigue, drowsiness, or poor habits; (3) control of situations in which the operator lets his emotions take hold; (4) optimization of learning processes to create machines which will take emotional effects into consideration; and (5) development of automatic recognition and tracking systems. M.W.R.

N66-24140# Joint Publications Research Service, Washington, D. C.

CORRELATION OF ADAPTIVE SYSTEMS OF VARYING DEGREES OF SPECIFICITY IN THE PROCESS OF PERCEPTION

A. Ye. Liberman *In its* Bionics 20 Apr. 1966 p 107–112 refs (See N66-24126 13-04) CFSTI: $9.10

An investigation is made of the adaptive-orienting interrelationship in the visual analyzer, with observations made of reactions of the pupil to various situations. An excitant, such as sound or smell, was used for the orienting reactions stimulus. When the pupils were dilated in response to these stimuli, the brightness of the visual image on the retina was increased and the level of sensitivity was, therefore, decreased. Absolute values for the orienting reflex of the pupil, calculated for responses made by 25 people without visual and sensitivity difficulties, turned out to be conjugate to the level of the photoadaptive tonus of the pupil. The relative value manifested in quite a broad range of artificial illumination. It is found that under the influence of a new nonvisual stimulus, image brightness on the retina is increased on the average of 20%. This reaction to new stimuli is considered a measure of the gradient of the orienting excitation which is relatively independent of the variations in the background stimulation. The interrelationships of the various adaptive systems which control perception are considered applicable to problems in pattern recognition, self-teaching machines, and the general fields of bionics and cybernetics. M.W.R.

N66-24141# Joint Publications Research Service, Washington, D. C.

PECULIARITIES OF CELLULAR AND SUBCELLULAR ORGANIZATION OF THE ORGANS OF SENSE IN THE LIGHT OF PROBLEMS IN BIONICS

Ya. A. Vinnikov *In its* Bionics 20 Apr. 1966 p 113–124 refs (See N66-24126 13-04) CFSTI: $9.10

A general discussion is presented on the peculiarities of cellular, subcellular, and molecular organization of the sense organs which enable the perception of various types of sensory stimuli. The sense organs of various animals are considered in terms of problems which may arise in the field of

bionics. From the bionics point of view it is the uniqueness of organization at the various levels of the sensory receptors that is of interest. M.W.R.

N66-24142# Joint Publications Research Service, Washington, D. C.

FREQUENCY CHARACTERISTICS AND ABSOLUTE THRESHOLD IN THE SENSITIVITY OF THE PHOTORECEPTORS OF CERTAIN INSECTS

N. V. Antakova, A. V. Kalinina, L. K. Len'shina, A. N. Malakhov, T. A. Russina et al *In its* Bionics 20 Apr. 1966 p 125–133 refs (See N66-24126 13-04) CFSTI: $9.10

Frequency characteristics and thresholds of vision for 73 species of insects were investigated by an electrophysical procedure which obtained an electroretinogram of the compound eye by use of tungsten microelectrodes. Frequency characteristics were obtained in a range of 0.1 to 100 cycles, and threshold sensitivity was determined in absolute units of the intensity of the light falling on the eye. For most of the insects it was found that the basic range of perception extends from 0.1 to 20 cycles per second; for humans the figure of 0.5 to 12 cycles is given. It is shown that insects which are basically diurnal, such as hymenoptera, dragonflies, diptera, and daylight butterflies, exhibit the least sensitivity to light. Nocturnal butterflies, on the otherhand, display considerably more sensitivity. M.W.R.

N66-24143# Joint Publications Research Service, Washington, D. C.

THE USE OF THE PROPERTIES OF VISION TO INCREASE THE SHARPNESS OF THE STEREOVISION OF A STEREOTELEVISION

S. M. Vilenskay, L. V. Ovchinnikov, and T. M. Tsykunova *In its* Bionics 20 Apr. 1966 p 134–138 refs (See N66-24126 13-04) CFSTI: $9.10

Influence of image outlining on stereo effect is studied in connection with the development of stereotelevision apparatus which can be remotely controlled. Outlining, which is used to increase resistance to noise, is found to increase the keenness of the stereovision of 10 examinees. Experiments were covered with both black and black–white outlining of the contrast image of the rods, with contrasts between 0.5 and 0.8; as well as with blackout lining of low contrast images in the order of 0.1. Greatest increase in keenness was obtained when outlining the low contrast images and also with frequent outlining of the contrast images. Certain corrections can be made for shifts between left and right channels and errors in transposition. M.W.R.

N66-24144# Joint Publications Research Service, Washington, D. C.

ON THE ROLE OF AFFERENTATION IN THE CONTROL OF THE MOTOR FUNCTIONS OF THE EYES

A. R. Shakhnovick *In its* Bionics 20 Apr. 1966 p 139–146 (See N66-24126 13-04) CFSTI: $9.10

An immovable blind spot, referred to as an artificial scotoma, was created in the center of field of vision in order to determine the role of afferentation in controlling the motor functions of the eyes. Six healthy humans were permitted to see surroundings in the peripheral field of vision but central vision was cut off by use of specially-constructed black damper. When the eyes were rotated an illusion of displacement of the scotoma resulted, an artificial dizziness occurred. One of the mechanisms for the dizziness is assumed to be the discord in the signals from the retina and from the centers of the voluntary eye movement. This is considered to be evidence of some mechanism in the center which controls eye movement. An apparatus using a mirror image was used to show that there is also a peripheral mechanism which controls voluntary movement of the eyes. It is concluded that eye motion is controlled by the complex interactions of afferentations such as the visual, vestibular, proprioreceptors of the eyes, and the neck muscles. M.W.R.

N66-24145# Joint Publications Research Service, Washington, D. C.

ON CONTROL OF THE TRACKING MOTIONS OF THE EYES

A. R. Shakhnovich, M. V. Dzhanelidze, and A. A. Inauri *In its* Bionics 20 Apr. 1966 p 147–153 (See N66-24126 13-04) CFSTI: $9.10

Basic characteristics and the extrapolation mechanism of tracking motions of the eyes are analyzed, and electroculograms are included for various motions. It is shown that the tracking motion of the eyes permits the holding of an image of a moving object relatively motionless on the retina, and this stabilization can be realized for quite an extended time without corrective jumps. It is the presence of the extrapolation mechanism which permits this. Investigations indicate that the tracking motions differ from all other types of eye movements and are more complex in organization. The control of tracking motions is considered to involve the highest level of oculomotor innervation, and because of the control complexity involved the present study is considered of a preliminary nature. M.W.R.

N66-24152# Joint Publications Research Service, Washington, D. C.

CONSTRUCTION OF AN AUTOMATIC CONTROL SYSTEM FOR THE CIRCULATORY SYSTEM

V. M. Khayutin *In its* Bionics 20 Apr. 1966 p 210–220 refs (See N66-24126 13-04) CFSTI: $9.10

The purposes of control and the general functioning of the circulatory system are considered in a paper dealing with the construction of an automatic control system for the circulatory system. The principles related to the control of blood circulation may be of interest to bionics because engineers engaged in the construction of various devices often encounter problems of optimal distribution of limited supplies of power and material. The discussion is divided into three stages, dealing with operating hyperemia, compensatory construction of the vessels, and optimization. According to the hypothesis presented, it is the third stage in control that optimizes the operation of the entire cardiovascular system. M.W.R.

N66-24153# Joint Publications Research Service, Washington, D. C.

THE POLYFERMENT SYSTEM OF A CELL AS THE OBJECT OF BIONIC INVESTIGATIONS

Ye. Ye. Sel'kov *In its* Bionics 20 Apr. 1966 p 221–228 refs (See N66-24126 13-04) CFSTI: $9.10

Any self-organizing system is considered to have the following properties: (1) variable parameters which determine the condition of conducting signals in the system, (2) feedback varying these parameters toward lightening the signals being sent, and (3) a memory. An attempt is made to show that such properties are inherent not only in complex polyferment systems, but also in simple fermentative reaction systems and even in these individual reactions. Each signal passing through the reaction leaves behind it a trace in the form of a deviation in the concentration of the free ferment from the

steady-state value, and the reaction is remembered. The described mechanism for remembering the reaction is called a dynamic memory with an exponential law of forgetfulness. It is concluded that the solution of such cellular organization problems may have applicability in the expedient solution of economic problems. M.W.R.

N66-24154# Joint Publications Research Service, Washington, D. C.

ON THE SIMULATION OF THE HUMAN MIND

N. M. Amosov, E. T. Golovan, S. Ya. Zaslavskiy, and V. S. Starinets *In its* Bionics 20 Apr. 1966 p 229–236 refs (See N66-24126 13-04) CFSTI: $9.10

The introduction of emotions into the operation of "intelligence" machines is considered, and specific cases discussed include: (1) assignment of emotions to elements of the input word and (2) development of an emotional state before the input word is introduced into the model. These are attempts to simulate thought functions in definite situations, and overcome some of the difficulties in heuristic approaches which do not account for peculiarities in the emotional sphere and the organization of the human memory. The model which is presented consists of seven conditionally separate blocks, namely: (1) input, (2) interaction, (3) emotions, (4) response, (5) analysis, (6) short-term memory, and (7) long-term memory. M.W.R.

N66-24188# Joint Publications Research Service, Washington, D. C.

A MODEL OF A HUMAN OPERATOR IN AN INPUT SYSTEM FOR A DIGITAL COMPUTER

V. T. Kulik *In its* Bionics 20 Apr. 1966 p 495–499 ref (See N66-24126 13-04) CFSTI: $9.10

A man–machine system, which employs a model for the human operator for input into a digital computer, was found to be satisfactory. The general diagram and equivalent mathematical model are given for the input system with an operator; and additional diagrams illustrate systems (1) of operational diagnostics, (2) for processing data from scientific experiments, and (3) of programed training. Characteristic errors of the operator are tabulated, and it is concluded that the proposed model can exclude random errors on the part of the operator when converting oscillograph recordings into digital form for inputs into the computer. M.W.R.

N66-24448# Joint Publications Research Service, Washington, D. C.

OCCUPATIONAL PECULIARITIES OF PERCEPTION OF ONE HUMAN BEING BY ANOTHER

A. A. Bodalev 25 Mar. 1966 21 p refs Transl. into ENGLISH from the book "Vospriyatiye Cheloveka Chelovekom" Leningrad, Publ. House of Leningrad Univ., 1965 p 106–122 (JPRS-34734; TT-66-31173) CFSTI: $1.00

The characteristics and behavior of an individual which impress persons belonging to different occupational groups were investigated. Groups of persons were asked what they noticed or remembered most about others. The groups included wrestlers talking about opponents, basketball coaches about players, teachers about pupils, and student artists about their classmates. It was found that the artist group provided particularly accurate evaluations of the subject with respect to proportions, shape, and location of features. In another study, choreography teachers described friends, and it was found that they stressed overall build and mobility. It was concluded that (1) the perception of one human being by another is a direct visual reflection of one human being by another; (2) the volume and degree of reliability of the information depend on the peculiarities of the person perceived and of the person perceiving; and (3) the perception is affected by conditions under which one person is perceived by the other. N.E.N.

N66-24463# Honeywell, Inc., St. Paul, Minn. Research Dept.

A STUDY OF VISUAL SEARCH USING EYE MOVEMENT RECORDINGS First Annual Report, 1 Jan.–31 Dec. 1965

L. G. Williams 28 Feb. 1966 79 p refs (Contract Nonr-4774(00)) (Rept.-12009-IRI; AD-629624) CFSTI: HC $3.00/MF $0.75

The object of study in the present program is visual search in crowded fields. The basic goal is to predict search times for arbitrary targets in arbitrary backgrounds. The basis of our framework is that the specific objects at which an observer looks depends on the specific targets for which he searches. The average time to find a given target depends on what types of objects he is likely to look at and the numbers and types of objects in the search field. The report contains three appendices. Appendix A describes the apparatus used in the present studies and the rationale for measuring eye fixations. Appendix B is a methodological study which establishes the validity of generalizing to the real world from the restrictive laboratory situation. Appendix C shows how eye fixation data can be used to predict search times for specific targets in arbitrary fields. TAB

N66-24470# Joint Publications Research Service, Washington, D. C.

TRANSLATIONS FROM *VOPROSY PSIKHOLOGII* (PROBLEMS OF PSYCHOLOGY), NO. 6, 1965

17 Mar. 1966 59 p refs Transl. into ENGLISH from Voprosy Psikhologii (Moscow), no. 6, Nov.–Dec. 1965 (JPRS-34596; TT-66-31035) CFSTI: $3.00

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N66-24548*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

STATE-OF-THE-ART BIOLOGICAL DATA HANDBOOK Final Report

M. A. Mc Lennan et al Aug. 1965 86 p refs (Contract NAS2-2479) (NASA-CR-74645; LMSC-4-05-65-4) CFSTI: HC $3.00/MF $0.75 CSCL 06B

This handbook is intended to furnish the user of biological data with a convenient source of information about the characteristics of available flight qualified or flight eligible sensors and equipment. Flight eligible indicates that the design is flight qualifiable but has not passed qualification tests.

This information will also enable the data user to make a first approximation of his data system size, the biological data loads, possible data compression techniques, and telemetry system capabilities. R.N.A.

N66-24557# Library of Congress, Washington, D. C. Aerospace Technology Div.
BIOELECTRICALLY CONTROLLED UPPER EXTREMITY PROSTHESES Surveys of Soviet Scientific and Technical Literature
Christopher H. Dodge 19 Apr. 1966 45 p refs Review Article
(ATD-66-46)

A Soviet literature review was conducted on all pertinent technical data available on the design, operation, and specifications of upper extremity prosthetic devices and components. The articles summarized in this paper deal with problems of the design, testing, and refinement of bioelectrically controlled upper extremity prostheses, especially prosthetic hands. Included are articles on electronic circuits for multifunctional prostheses with bioelectric control, modes of controlling multifunctional bioelectric prostheses, design requirements for a feedback scheme for sensing grasping force in bioelectric prostheses, distribution of mass in forearm prostheses, electric activity of muscles operating at TsNIIPP arm prosthesis, methods of testing miniaturized reducing gear assemblies, a hand for bioelectrically controlled prostheses, and servomotor drive for a prosthetic hand. Also included are summaries of two articles on applications of bioelectric control research in space and industry. R.N.A.

N66-24569# Grumman Aircraft Engineering Corp., Bethpage, N.Y.
RADIATION SHIELDING CONSIDERATIONS FOR INTERPLANETARY SPACECRAFT
Carl F. Kottler, Jr. Jan. 1966 48 p refs
(RE-236)

This report presents an analysis of the radiation dosage astronauts would receive when protected by various combinations of passive shielding, as a function of mission duration and the probability of exceeding the statistically predicted dosage of the NASA model solar proton environment. Dosages to the internal organs and the skin (taking into account self-shielding) are determined as a function of the energy of the incident particles, and are compared with permissible dosages. The shielding and associated effective cutoff energies required for protection against alpha particles and protons are calculated for mission durations between 1 week and 2 years, with three probabilities of exceeding the indicated dosages (0.1, 0.01, and 0.001). Parametric curves for typical aluminum structure, polyethylene shield, hydrogen fueled spacecraft are shown. An introductory description of the solar atmosphere, solar activity, and associated geomagnetic phenomena is also presented along with a number of reference tables. Author

N66-24561# Federal Aviation Agency, Oklahoma City, Okla.
EQUIDISTANCE TENDENCY AND ITS CONSEQUENCES
Walter C. Gogel Apr. 1965 19 p refs
(AM-65-11)

The equidistance tendency is the tendency for objects or other inhomogeneities in the field-of-view to appear at the same distance as each other with the strength of this tendency being inversely related to directional separation. The evidence for the existence of the equidistance tendency and for its ability to modify the perceived depth resulting from size or stereoscopic cues is reviewed. The equidistance tendency is discussed as a disturbing factor in visual experimentation and as a necessary factor in the understanding of Emmert's law, the moon illusion, and similar phenomena. Several possible explanations for the equidistance tendency are evaluated in terms of the range of phenomena with which it is identified. Author

N66-24676# Federal Aviation Agency, Oklahoma City, Okla. Office of Aviation Medicine.
DETERMINATION OF CENTERS OF GRAVITY OF CHILDREN, SITTING AND STANDING
John J. Swearingen and Joseph W. Young Sep. 1965 17 p refs
(AM-65-23)

There have been numerous instances in which small children have been thrown out over the top of the seat belt in rough air and airline crashes, indicating that the present seat belt is not a satisfactory restraint device for children 2 to 10 years old. Data defining the location of the center of gravity of children of different ages in the sitting position have not been available and are urgently needed to serve as a basis for developing an improved restraint system for children. To supply these data for design requirements approximately 1,200 children (ages 5 to 18) were balanced on a specially designed center-of-gravity machine in sitting and standing positions. The center of gravity of small children in the standing position will be most useful in the design of flotation equipment. This study shows that the center of gravity for small children sitting in an airline seat is located roughly 5 in. above the seat belt and explains why children slip out over the seat belt during crash decelerations. Complete data of location of centers of gravity along with anthropometric data of the children studied are presented. Author

N66-24740# Wichita Univ., Kans. Dept. of Aeronautical Engineering.
INVESTIGATION OF THE CONCEPT OF DIRECT FLIGHT CONTROL Final Report
Andrew Craig Aug. 1965 36 p refs
(Contract DA-31-124-ARO(D)-231)
(AR-65-1; AROD-4837-1; AD-628087) CFSTI: HC $2.00/MF $0.50

A system which provides direct and independent control of flight path speed, heading, and angle with the horizon was synthesized and evaluated in an analog computer simulation. Performance by subjects whose piloting experience varied from zero flight hours to four thousand flight hours was compared using direct control and conventional control systems. Two primary results were obtained: first, the performance of a subject with no flight experience using direct control was equal or superior to the performance of a subject of 4,000 hours experience using conventional controls, performance being measured in terms of mean square deviation from a prescribed flight path; second, performance improvement varied inversely with pilot experience. The resulting control scheme utilized closed-loop devices with emphasis placed on simplicity and reliability. Author (TAB)

N66-24773# Pittsburgh Univ., Pa. Graduate School of Business.
DIFFERENTIAL RESPONSE TO APPRAISAL AND GOAL SETTING AS A FUNCTION OF SELF, INTERACTION AND TASK ORIENTATION
Bernard M. Bass May 1964 18 p refs
(Contract Nonr-624(14))
(TR-3; AD-600296) CFSTI: $0.50

Sixty graduate students met periodically for 15 weeks in training groups. Midway, half of the men were counseled individually 1 to 1-1/2 hours by a peer from the other half. The counselees were the men most extreme in scores in self, interaction or task-orientation. The counselors were the remaining men. Counseling was devoted either to appraising past performance or to setting future goals. Generally, self-oriented students were significantly less likely to agree with their counselors as to what had been discussed in counseling and to particularly favor past performance appraisal over future goal setting. Author (TAB)

N66-24782# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
A PRELIMINARY STUDY OF ACQUIRING CROSS-CULTURAL INTERACTION SKILLS THROUGH SELF-CONFRONTATION Final Report, Jul.–Aug. 1964
Donald B. Haines and Herbert T. Eachus Sep. 1965 50 p refs
(AMRL-TR-65-137; AD-624120) CFSTI: HC $2.00/MF $0.50

An experiment was carried out to assess the relative effectiveness of two methods of training USAF military advisors in cross-cultural skills. A scenario was constructed requiring subjects to play the role of an American USAF Captain who had to interact, in specified ways with a 'foreign counterpart,' a role played by an actor. A list of 34 behaviors appropriate to the situation and fictitious culture were provided the subject. The behaviors required ranged from actions, gestures, etc. which were similar to those in our own society, to those which were considerably different. Twenty-three male subjects were divided into control and experimental groups and taught the desired behaviors by two methods: (1) Verbal coaching after a role-playing session (2) selfconfrontation by a videotape replay after a role-playing session. Considerable improvement resulted from these methods. The experiment confirmed the effectiveness of self-confrontation as a training technique for the rapid acquisition of complex and subtle skills of interaction—an area of difficulty encountered by USAF advisors on counterinsurgency training missions. Author (TAB)

N66-24827# Public Health Service, Cincinnati, Ohio. Occupational Health Research and Training Facility.
CORRELATION OF OBJECTIONABILITY RATINGS OF NOISE WITH PROPOSED NOISE-ANNOYANCE MEASURES
Alexander Cohen and Richard F. Scherger May 1964 20 p refs (RR-3)

In a laboratory setting, recorded samples of roadway noise, aircraft flyover noise, and train noise were presented in a forced-choice, paired-comparison fashion to 100 listeners who judged which of the two noises in each pair was more objectionable. Such judgments yielded scaled objectionability ratings for the noise samples. These scaled ratings were correlated with A-scale sound level readings of the noises in decibels (dB), and with conversions of their physical measurements into subjective magnitudes of loudness in phon units as computed by Stevens' and by Zwicker's techniques, and with perceived noisiness in dB as determined by Kryter's procedure. Each of these measures has been reputed to provide quantifiable estimates of noise-annoyance and did, in fact, supply values significantly correlated with the obtained scale of subjective ratings. Loudness in phons, using Zwicker's calculations, gave values which corresponded best with the scaled listener annoyance judgments (r=.96). Author

N66-24839# Joint Publications Research Service, Washington, D. C.
DEVELOPMENTS IN PROGRAMMED LEARNING AND TEACHING MACHINES
L. Ivanenko et al 5 May 1966 22 p Transl. into ENGLISH from Tekhn. Molodezhi (Moscow), no. 3, 1966 p 10–13
(JPRS-35357; TT-66-31793) CFSTI: $1.00

This paper contains several brief articles concerned with Soviet developments in programmed learning and teaching machines. Included are articles on the lack of progressive education, teaching machines and individual progress, automated questioning sessions, the Tutor-2 teaching machine, tape recorder with student response and pause signal, teaching machine for music students, and technology, school, and Communism. R.N.A.

N66-24865*# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.
MAN SYSTEM CRITERIA FOR EXTRATERRESTRIAL SURFACE ROVING VEHICLES Interim Technical Report
R. M. Nicholson and J. E. Haaland 7 Feb. 1966 342 p refs *Its* Rept.-12504-ITR1
(Contract NAS8-20006)
(NASA-CR-74743) CFSTI: HC $7.00/MF $1.75 CSCL 05H

A broad study in which the objectives were (1) to develop minimum and optimum cabin free volume design criteria for extraterrestrial surface roving vehicles and systems, (2) to define the equipments and cabin volumes associated with the crew's sleeping requirements, and (3) to define the procedural and volumetric requirements associated with emergency operation of the system is presented. Areas discussed include airlock simulators; crew tasks and task measures; sizing tests; rescue mission tests; and environmental control system failure tests. Numerous observations are made, and data curves, other types of illustrative graphs, data tables, and photographs are given. L.S.

N66-25039# Sandia Corp., Albuquerque, N. Mex. Aerospace Nuclear Safety Div.
AERO HEATING RESULTS FROM THE RFD-2 FLIGHT TEST
A. J. Clark, Jr. 8 Oct. 1965 16 p Presented at the 13th Conf. on Remote Systems Technol., Washington
(Contract AT(29-1)-789)
(SC-DC-65-1601; CONF-651101-37) CFSTI: HC $1.00/MF $0.50

The Re-entry Flight Demonstration No. 2 test was conducted to study the response of the isotopic generator during the re-entry portion of the flight. The primary objective of this flight test was to study generator disassembly and fuel capsule burnup as a result of re-entry heating. Data obtained by thermocouple measurements are presented. NSA

N66-25166# Bureau of Mines, Pittsburgh, Pa.
RESPIRATORY PROTECTIVE DEVICES APPROVED BY THE BUREAU OF MINES AS OF OCTOBER 1, 1965
R. H. Schutz, B. I. Ferber, and E. J. Kloos 1966 32 p refs
(BM-IC-8281) GPO: $0.25

This report lists all active respiratory protective devices that have been approved by the Bureau of Mines as of October 1, 1965. These devices include self-contained breathing apparatus, gas masks, supplied air respirators, dispersoid (dust, fume, and mist) respirators, and nonemergency gas respirators. These devices are currently manufactured and

sold, and are listed with the manufacturer's current designation. Inactive devices, listed in appendix A, are no longer manufactured but retain their approved status. The addresses of the manufacturers of approved active respirators are listed alphabetically in appendix B. R.N.A.

N66-25172# Joint Publications Research Service, Washington, D. C.
METHODS OF STUDYING INDUSTRIAL DUST AND THE INCIDENCE OF PNEUMOCONIOSES
A. A. Letavet and Ye. V. Khukhrina, ed. 11 Mar. 1966 116 p refs Transl. into ENGLISH of the book "Metody Izucheniya Proizvodstvennoy Pyli i Zabolevayemosti Pnevmokoniozami" Leningrad, Med. Publishing House, 1965 p 1–123
(JPRS-34512; TT-66-30952) CFSTI: $4.00

CONTENTS:

1. EVALUATION OF THE MODERN METHODS OF DETERMINATION OF THE AMOUNT AND DISPERSITY OF DUST Ye. V. Khukhrina p 5–9

2. METHODS OF DETERMINATION OF THE DEGREE OF CONTAMINATION OF AIR WITH DUST USING AEROSOL ANALYTICAL FILTERS (AAF) A. I. Vronskiy and V. B. Latushkina p 9–17 refs

3. INVESTIGATION OF THE DUST CONTENT OF AIR BY THE ULTRAMICROSCOPY METHOD I. A. Kovalevich p 17–22 refs

4. COMPARATIVE EVALUATION OF NEW METHOD OF DETERMINATION OF THE DUST CONTENT OF AIR A. I. Vronskiy, A. S. Slutsker, and Ye. V. Khukhrina p 22–32 refs

5. COMPARATIVE EVALUATION OF TWO GRAVIMETRIC METHODS OF DETERMINATION OF DUST CONCENTRATION IN MINE AIR Ya. Shimechek, V. V. Tkachev, and A. M. Shevchenko p 33–38 refs

6. STUDY OF THE PARTICLE SIZE DISTRIBUTION OF DUST BY THE MICROSCOPY METHOD T. T. Lobova p 39–43

7. APPARATUS FOR THE MICROSEDIMENTATION ANALYSIS OF PARTICLE SIZE DISTRIBUTION OF DUST A. I. Vronskiy p 43–48 refs

8. ON THE DETERMINATION OF THE DEGREE OF DISPERSION OF WATER FOG K. A. Galkina and A. S. Slutsker p 49–52 refs

9. METHODS OF DETERMINATION OF FREE SILICON DIOXIDE IN DUST V. I. Kireyev p 52–60 refs

10. THE COUNTING-COLOR METHOD OF DETERMINATION OF THE MINERAL COMPOSITION OF DUST P. I. Tyutin p 60–66 refs

11. PROCEDURE FOR INVESTIGATION OF THE EFFICIENCY OF DUST-ABATEMENT EXHAUST SYSTEMS V. G. Matsak and A. S. Slutsker p 66–96 refs

12. METHODS OF THE STUDY OF OCCURRENCE OF PNEUMOCONIOSES Ye. V. Khukhrina and N. V. Dogle p 97–107

N66-25183# Joint Publications Research Service, Washington, D. C.
THE CENTRAL IDEAS AND PHILOSOPHICAL PRINCIPLES OF CYBERNETICS
V. D. Moiseyev 21 Apr. 1966 239 p refs Transl. into ENGLISH of the book "Tsentral'nyye Idei i Filosovskiye Osnovy Kibernetiki" Moscow, "Mysl" Publishing House, 1965 p 1–326
(JPRS-35136; TT-66-31573) CFSTI: $6.00

This work is an attempt to summarize and systematize the central ideas and philosophical principles of cybernetics. Included are sources, main concepts, and certain philosophical questions concerning cybernetics; ideas on feedback mechanisms in living and inanimate self-controlled systems; ideas about information in living and inanimate self-controlled systems; and ideas on automatic computers as machines of a special type capable of executing functions analogous to human thought. R.N.A.

N66-25185# Federal Aviation Agency, Washington, D. C. Office of Aviation Medicine.
ANTHROPOMETRY OF AIR TRAFFIC CONTROL TRAINEES
Clyde C. Snow and Richard G. Snyder Sep. 1965 33 p refs (AM-65-26)

This report presents the body measurements of 684 air traffic control trainees enrolled in training programs conducted at the Federal Aviation Agency Aeronautical Center at Oklahoma City between August 12, 1960, and June 30, 1961. It includes the means, standard deviations, coefficients of variation, percentiles, and related statistics of 60 standard anthropometric and functional measurements. The survey was initiated to provide adequate criteria for improving the workspace design for the air traffic controller and to provide anthropometric baseline data for future biometric and aging studies of Air Traffic Service personnel. Author

N66-25281# RAND Corp., Santa Monica, Calif.
A DIFFUSION-EQUATION MODEL FOR NEURON FIRING WITH EXPONENTIAL DECAY OF POTENTIAL
Brian Gluss Mar. 1966 31 p
(Grant NIH GM-09608)
(RM-4857-RC)

A neuron is assumed to receive synaptic input of both excitatory and inhibitory natures from a large number of neighboring neurons; it is also assumed that a large number of such impulses are required to raise the neuron's transmembrane potential to its threshold potential, at which it fires. The model is an extension of the Gerstein and Mandelbrot model, in which, in the absence of input, an exponential decay of potential toward a resting level is introduced. Computational methods of determining the firing time interval distribution are discussed, along with the inverse problem of estimating the parameters of the system from observed firing time interval data. These parameters are: the restoration potential following a firing; threshold potential; absolute refractory period; resting potential level; and the statistical properties of the excitatory and inhibitory impulses. D.T.

N66-25285# Joint Publications Research Service, Washington, D. C.
APPLICATION OF BIONICS TO THE FIELD OF STANDARDIZATION
13 May 1966 15 p Transl. into ENGLISH from Standarty i Kachestvo (Moscow), no. 1, 1966 p 42–45
(JPRS-35502; TT-66-31938) CFSTI: $1.00

The importance of bionics in modern technology, in general, and in the field of standardization, in particular, is discussed in an editorial. A narrative account is given, describing existing and proposed machines for simulating and utilizing biological and physiological processes. Finally, a second narrative account is devoted to the establishment of mutual ties among bionics, standardization, and technical esthetics. D.T.

N66-25296# Joint Publications Research Service, Washington, D. C.
DIARY OF A PILOT-COSMONAUT
N. S. Khekhlovskaya, ed. 5 Jun. 1964 47 p Transl. into ENGLISH of the Booklet "Dnevnik Letchika-Kosmonavta K." "Sov. Rossiya" Publishing House, 1963 p 1-78
(JPRS-24973; OTS-64-31430) CFSTI: $1.25

This article presents the diary of a Soviet pilot-cosmonaut and includes his comments on space flight, the Soviet space program accomplishments, and the day to day activities of the cosmonaut training program. R.N.A.

N66-25312# Joint Publications Research Service, Washington, D. C.
THEORY AND PRACTICE OF PROGRAMMED INSTRUCTION
L. T. Pesochina et al 19 Nov. 1965 13 p Transl. into ENGLISH from Vestn. Vysshey Shkoly (Moscow), no. 3, Mar. 1965 p 19-24
(JPRS-32942; TT-65-33519) CFSTI: $1.00

CONTENTS:

1. SUPERVISION OVER STUDIES ON RESISTANCE OF MATERIALS WITHOUT USING MACHINES L. T. Pesochina, G. A. Mirze, and M. K. Molochnikova p 1-5
2. SCIENTISTS DISCUSS THE METHODS OF PROGRAMMED INSTRUCTION G. S. Tsov'yanov p 6-9

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N66-23888# Naval Radiological Defense Lab., San Francisco, Calif.
DISCONTINUITIES IN THE SURFACE STRUCTURE OF ALCOHOL-WATER MIXTURES
Boleslaw L. Dunicz 4 Nov. 1965 49 p refs
(USNRDL-TR-951; AD-628351) CFSTI: HC $2.00/MF $0.50

Interpretations vary regarding relationships between surface tension and concentrations of binary liquid solutions. These interpretations are based upon a scanty number of observations and do not take into account the possibility that the mutual molecular arrangement of the components on the surface may tend to follow some particular patterns, which undergo modifications at certain critical compositions of the liquids. Surface tension determinations were obtained by the capillary rise method for two systems: methyl alcohol-water, and ethyl alcohol/water, at 25°C, throughout the whole range of concentrations, with over 80 experimental points obtained for each system. Plots of the Langmuir isotherm confirmed the validity of the proposed conjecture. The plots of the MeOH-H_2O and EtOH-H_2O consist of twelve and eleven rectilinear segments, respectively. A detailed interpretation of the data is presented. TAB

N66-23897# Midwest Research Inst., Kansas City, Mo.
DETERMINATION OF MIXED VIRIAL COEFFICIENTS
Final Technical Report
Jerome Brewer Dec. 1965 40 p refs
(Contract AF 49(638)-1190)
(AFOSR-66-0411; AD-628889) CFSTI: HC $2.00/MF $0.50

An experimental apparatus has been constructed and developed and with it the interaction second virial coefficients have been measured from −125° to 50°C in 25°C increments for the following systems: N_2-Ar, Ar-H_2, Ar-He, Ne-Ar, N_2-H_2, N_2-He, Ne-N_2, H_2-He, Ne-H_2 and Ne-He. The excess and interaction second virial coefficients were determined usually within 0.1 cc/mole corresponding to an error in the ratio $\Delta P/P$ of 5×10^{-6}, by measuring the pressure change of mixing two pure gases at constant temperature and volume. This precision corresponds to about one part in 200,000 for conventional PVT experiments. The comparison between experimental values and those calculated by the Kihara potential was considered good at the higher temperatures and fair to poor at the lower temperatures where it was as much as 8 cc/mole. In the temperature range of −125° to 50°C, the excess quantity, E, was empirically correlated to the absolute temperature by the relation, $E=aT^b$ where the value of b was essentially the same for most of the binary mixtures.
Author (TAB)

N66-23923# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF THE ROLE OF FREE RADICALS IN THE ACETALDEHYDE POLYMERIZATION PROCESS IN THE SOLID PHASE UNDER γ-IRRADIATION
V. S. Pshezetskiy and V. I. Tupikov 5 Nov. 1965 18 p refs Transl. into ENGLISH from Geterotsepnyye Vysokomol. Soyedineniya, Sb. Statey (USSR), 1963, p 213-219
(FTD-TT-65-978/1+2; TT-66-60577; AD-628301) CFSTI: HC $1.60/MF $0.50

The EPR method was used to investigate the processes of formation and recombinations of the radicals that form in crystalline acetaldehyde under gamma-irradiation. It was established that in the dose range from 0.1 to 10 Mrad, the radical concentration corresponds in order of magnitude to the concentration of polymer chains. Radical recombination takes place abruptly at temperatures coinciding with the 'critical' temperatures determined by the thermography method. It was found that monomolecular rupture takes place at small radiation doses; at larger doses (0.2 Mrad and up), chain rupture takes place in accordance with a bimolecular law. UV radiation initiates polymerization of crystalline acetaldehyde. The nature of the radicals that appear corresponds perfectly to that of the radicals formed on exposure to gamma-radiation; the concentration of the radicals corresponds to that of the molecular chains. The results obtained justify the assumption that polymerization of crystalline acetaldehyde proceeds by the radical mechanism when initiated by either ionizing radiation or ultraviolet light. Author (TAB)

N66-23943# Institute for Organic Chemistry TNO, Utrecht (Netherlands).
SYNTHESIS OF GROUP IV ORGANOMETALLIC POLYMERS AND RELATED COMPOUNDS Summary Technical Report, Mar. 1959-Feb. 1964
A. J. Leusink, J. G. Noltes, H. A. Budding, and G. J. M. van der Kerk Wright-Patterson AFB, Ohio, AF Mater. Lab., Dec. 1965 98 p refs
(Contract AF 61(052)-218)
(AFML-TR-65-192; AD-629554) CFSTI: HC $3.00/MF $0.75

The synthesis and characterization are described of linear polymers, having a carbon chain regularly interrupted by the Group IV elements silicon, germanium, tin, or lead. Such

polymers were obtained by means of: (1) poly-addition reactions involving an organotin dihydride and either a dienic, a diynic, or a monoynic compound; (2) Wurtz-type poly-condensations involving appropriate combinations of p-chlorophenyl and chloro derivatives of the Group IV elements. The synthesis and polymerization of vinyl-type Group IV organometallic monomers is dealt with briefly. Furthermore, interesting Group IV metal-containing heterocycles were prepared and also a few polymers containing, in addition to Group IV atoms, other heteroelements in their backbone. All polymer-forming reactions were studied by carrying out model reactions on a low-molecular weight level. Author (TAB)

N66-23963# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
THE EFFECT OF CHEMICAL COMBINATION ON THE SOFT X-RAY K EMISSION BANDS OF NITROGEN AND CARBON Technical Report, Jan.-Apr. 1965
David W. Fischer and William L. Baun Nov. 1965 20 p refs
(AFML-TR-65-255; AD-629103) CFSTI: HC $1.00/MF $0.50

Chemical combination has a marked effect on the shape of the X-ray K emission bands of nitrogen and carbon. Nitrogen bands from a few nitrides and carbon bands from graphite, diamond, lampblack and some metallic carbides are shown. The wavelengths of the most prominent parts of the bands are listed as are the half bandwidths and full bandwidths. Results were obtained using electron excitation, a lead stearate crystal and flow proportional counter. Author

N66-24045# Carnegie Inst. of Tech., Pittsburgh, Pa.
THE ADSORPTION OF SULFUR ON COPPER
H. E. Collins and P. G. Shewmon 1 Mar. 1966 31 p refs
(Contract Nonr-760(19))
(TR-2; AD-629483) CFSTI: HC $3.60/MF $0.50

A study was made to determine the sites at which sulfur adsorption occurs on copper surfaces. Measurements were made of the relative torques, τ/γ_s, at the intersection of twin boundaries with surfaces near the three low index orientation, i.e., (100), (110), and (111), over a range of H_2S/H_2 ratios. H_2S concentrations from 3 to 1500 ppm between 83° and 105°C were used. It is concluded that sulfur adsorption occurred perferentially though not exclusively at edge sites near the (100) and (110) surfaces in the H_2S range $\lesssim$700 ppm giving rise to negative torques near these orientations. Beyond this H_2S range, adsorption occurred at all sites. Near the (111) surface τ/γ_s varied little with H_2S concentration up to approximately 75 ppm. Above this range, the results indicated that adsorption is occurring on both terrance and edge sites. Author (TAB)

N66-24084# California Univ., Berkeley. Dept. of Chemistry.
MOLECULAR ORBITAL THEORY IN ORGANIC CHEMISTRY Final Report, 1 Oct. 1961-30 Sep. 1965
Andrew Streitwieser, Jr. [1965] 18 p refs
(Grants AF-AFOSR-62-175; AF-AFORSR-554-64)
(AFOSR-66-0185; AD-628297) CFSTI: HC $1.60/MF $0.50

In carbonium ion reactions, acetolysis of benzyltosylates of 40C give the following relative rates: m-Cl, 0.56; p-Cl, 0.51; H, 1.00; p-F, 3.4; P-CH3, 60. The conductivity method developed is now being applied to polycyclic arylmethyltosylates for application of M.O. theory. In carbanion reactions, pK's were measured towards cesium cyclohexyamide in cyclohexylamine of 14 hydrocarbons. Representative values are 9-phenylfluorene (18.49); indene, 19.93; fluorene, 22.74; triphenylmethane, 31.48; diphenylmethane, 33.09. HMO theory gives a poor correlation of these data. Exchange rates were measured for other hydrocarbons of interest with lithium and cesium cyclohexylamide and the reactions were demonstrated to involve carbanionic intermediates and to provide valid measures of hydrocarbon acidities. The exchange rates of polycyclic methylarene-ad's and of arene-d (or t)'s are poorly correlated by HMO theory. In the arene case, a simple inductive field effect model was successful. An attempted synthesis of octalene was unsuccessful. Author (TAB)

N66-24085# Northwestern Univ., Evanston, Ill.
[MONOENERGETIC PHOTOLYTIC REACTIONS] Final Report, 1 Oct. 1961-1 Oct. 1965
E. W. Schlag [1965] 10 p refs
(Grants AF-AFOSR-62-83; AF-AFOSR-524-64)
(AFOSR-66-0153; AD-628328) CFSTI: HC $1.10/MF $0.50

The photolysis of cylcobutanone was investigated. Some work on the mechanism confirmed that it was a simple photolytic decomposition. One of the directly formed products is cyclopropane. Since the light quantum excites cyclobutanone with about 112 kcal/mole, the initially formed cyclopropane will similarly be highly excited. In fact the energy of the cyclopropane can be varied continuously since the wavelength irradiating the cyclobutanone can be varied continuously. A vibrationally excited molecule is thus had whose decomposition can be studied as the excitation energy is varied. Such systems are needed as test cases in the theory of reaction rates. Much time was spent developing an adequate theory for these reactions. A new way of analyzing rate equations was proposed, for molecular systems that undergo reactions from many quantum levels. Some work in the vacuum ultraviolet region was also done. A high intensity light source was developed for use in this region, operated by microwaves at high power. With this source and a monochromator, thresholds for ionization of inorganic molecules were measured. Investigations relevant to the theory of absolute reaction rates were also performed. Author (TAB)

N66-24118*# Stanford Research Inst., Menlo Park, Calif.
STUDY OF GROWTH PARAMETERS FOR REFRACTORY CARBIDE SINGLE CRYSTALS Quarterly Status Report No. VIII, 1 Dec. 1965-1 Mar. 1966
R. W. Bartlett 5 Apr. 1966 15 p ref *Its* Rept.-8
(Contract NASr-49(19))
(NASA-CR-74012) CFSTI: HC $1.00/MF $0.50 CSCL 07D

The results of some initial experiments in the growth of refractory carbide crystals are reported. These experiments involved an attempt to transfer tantalum carbide from a nutrient zone across a thin liquid metal zone to a seed area for the growth of tantalum carbide. Various experimental procedures are described and the results of these experiments are assessed. A mixed solid solution crystal growth experiment was performed using an aluminum menstruum. In addition to the aluminum, the menstruum contained a 50-50 stoichiometric ratio of hafnium and tantalum, and carbon in excess of the amount required to form the monocarbides. After dissolving the aluminum in hydrochloric acid, a purple residue of fine crystals was obtained, and X-ray diffraction analysis of this material showed that two separate carbide phases were present. Further analysis confirmed that two solid solutions with distinct compositions were formed, suggesting partial solid immiscibility in these monocarbides. An analysis of crystal growth using the Verneuli technique is included and the modifications of the apparatus that is to be used in growing carbide crystals using this method are discussed. H.S.W.

N66-24213# Commissariat a l'Energie Atomique, Paris (France).
HEAVY ELEMENTS CONTENT MEASUREMENT BY MEANS OF GAMMA-EXCITED X-RAY FLUORESCENCE
P. Martinelli and P. Blanquet (Soc. Minerais et Metaux) *In* ORNL Proc. of Symp. on Low-Energy X-ray Sources and Gamma Sources and Appl. Nov. 1965 p 107–123 refs Presented at the Symp. on Radiochem. Methods of Analysis, Salzburg, Austria, 19–23 Oct. 1964 (See N66-24206 13-24)
CFSTI: HC $4.00/MF $1.75

Use of radioisotopes as excitation sources in X-ray fluorescence analysis is discussed. The measurement of heavy metal contents by evaluation of their γ-excited characteristic λ X-rays is considered. Experimental apparatus and theoretical calculations are described. Application of the method to the determination of lead in powdered mixtures of PbS-SiO_2-FeS_2-ZnS is described. Determinations of tungsten in steel, and Bi, Pb, Hg, and W in aqueous solutions are discussed. NSA

N66-24218# United Kingdom Atomic Energy Authority, Wantage (England). Wantage Research Lab.
ORE AND COAL ANALYSIS USING RADIOISOTOPE TECHNIQUES
J. R. Rhodes *In* ORNL Proc. of Symp. on Low-Energy X-ray Sources and Gamma Sources and Appl. Nov. 1965 p 206–221 refs (See N66-24206 13-24) CFSTI: HC $4.00/MF $1.75

X-ray excitation by radioisotope sources and energy selection with filters are briefly reviewed and discussed. A new arrangement of source and secondary target for efficient production of spectrally pure K X-rays is described and its use in X-ray fluorescence analysis to obtain detection limits of 10 to 40 ppm of tin in tin ores is reported. Three methods of reducing inaccuracy due to matrix absorption effects are described with special reference to analysis of zinc, copper, and tin ores and to coal-ash monitoring. Errors of this nature, which can exceed 30%, have thus been reduced to ~1%. The results are being applied to development of apparatus for laboratory and on-stream analysis of coal and ores. An isotope portable analyzer is being made commercially available for geological applications in prospecting and field assay and for industrial use in measurements of coating thickness and alloy composition. Author (NSA)

N66-24244# United Kingdom Atomic Energy Authority, Harwell (England). Health Physics and Medical Div.
THE DETERMINATION OF PROTACTINIUM-231 IN URINE
F. J. Sandalls Dec. 1965 23 p refs
(AERE-R-4911) HMSO: 4s

A sensitive method for the determination of protactinium 231 in urine is described. The urine is wet-ashed with nitric acid and dissolved in a solution of hydrochloric and hydrofluoric acids. After saturating the solution with aluminum chloride, the protactinium is extracted into di-isobutyl ketone. A solution of hydrochloric and hydrofluoric acid is then used to extract the protactinium from the ketone. The hydrochloric–hydrofluoric acid solution is evaporated to dryness, the residue taken up in hydrochloric acid and the protactinium electrodeposited onto platinum from a solution of ammonium chloride. An overall recovery of 82±5 percent is obtained and decontamination from other alpha emitters is high. The electrodeposited protactinium may be counted with conventional or solid state detectors but is also in a suitable form for autoradiographic counting techniques. The limit of detection is about 0.03 pCi. Author

N66-24311# European Atomic Energy Community, Brussels (Belgium). Chemistry Dept.
DETERMINATION BY NEUTRON ACTIVATION ANALYSIS OF IMPURITIES IN SOME MATERIALS STRONGLY ACTIVATED UPON IRRADIATION [DETERMINATION PAR ACTIVATION AUX NEUTRONS D'IMPURETES DANS QUELQUES MATERIAUX S'ACTIVANT FORTEMENT AU COURS DE L'IRRADIATION]
R. Pietra, E. Sabbioni, and J. Pauly Mar. 1966 36 p refs In FRENCH; ENGLISH summary
(EUR-2753.f) CFSTI: HC $2.00/MF $0.50

In a determination of rubidium content in minerals, rubidium 86 was separated from other elements by means of adsorption on ammonium-phosphomolybdate. In an analysis of monocrystals of potassium halogenides, sodium and bromine were determined after the elimination of the excess activity of potassium 42; the potassium was precipitated as potassium chloride using gaseous hydrogen chloride. The chlorine in potassium bromide was analyzed with the elimination of the bromine before irradiation. The yield of the separation was followed using chlorine 38 as a tracer. In a study of impurities in semiconductor materials, lithium was determined in silicon crystals; the sample was dissolved and the solution was irradiated in order to produce the fluorine isotope. The effect of the purity of the reagents was examined. Phosphorus was determined in germanium by eliminating the strongly activated isotopes of germanium and arsenic by distillation. D.T.

N66-24314# Library of Congress, Washington, D. C. Aerospace Technology Div.
SOVIET RESEARCH IN SEMICONDUCTING POLYMERS. I. HEAT-TREATED POLYACRYLONITRILE
Serge Markov *In its* Foreign Sci. Bull., Vol. 2, No. 2 Feb. 1966 p 8–25 refs (See N66-24312 13-34)

Soviet research on a semiconducting polymer, heat-treated polyacrylonitrile, is reviewed. The research involved preparation and fabrication, collection of electrical data, elucidation of the electrical conduction mechanism, and relating of this mechanism to the chemical structure and morphology. Author

N66-24384 Picatinny Arsenal, Dover, N. J. Ammunition Engineering Directorate.
EVALUATION OF INORGANIC NITRATES AS HEAT TEST STANDARDS. ICRPG WORKING GROUP ON ANALYTICAL CHEMISTRY, ROUND ROBIN NO. 24
Milton Roth Dec. 1965 46 p refs Presented at the 22d Meeting of the Interagency Chem. Rocket Propulsion Group (ICRPG) on Anal. Chem., Cleveland, 3–5 Nov. 1965
(PA-TR-3287; AD-626171) CFSTI: HC $2.00/MF $0.50

$Al(NO_3)_3 \cdot 9H_2O$ and $Cu(NO_3)_2 \cdot 3H_2O$ are suitable for use as standards in the potassium iodide and methyl violet heat tests. In addition to being more stable than the organic nitrates currently used as standards, these inorganic nitrates are safer to store and easier to obtain at a prescribed level of purity. Standardization of the heat test can be improved if inorganic nitrates are distributed with the test papers along with a statement of the test time at a given temperature. Author (TAB)

N66-24390*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INTERSTELLAR MOLECULE FORMATION

Theodore P. Stecher and David A. Williams Feb. 1966 36 p refs
(NASA-TM-X-55462; X-613-66-72) CFSTI: HC $2.00/MF $0.50 CSCL 07D

The formation of interstellar molecules is shown to be the result of chemical exchange reactions between atoms of the interstellar gas and atoms chemically bound to the interstellar grains. It is first shown that molecular formation by the physical absorption of the constituents on the grain with a subsequent three body reaction is of no consequence for graphite grains and Platt particles. The theory of chemical exchange is shown to apply to all types of grains and is illustrated with graphite flakes. Production rates are given for H_2, CH, OH, NH, CN, CO, and N_2 as functions of temperature and pressure. Destruction of the molecules is due to photodissociation by starlight and also by other chemical exchange reactions. The varying conditions in the interstellar medium are considered. No molecules are formed when the gas is cold and quiescent. With the higher temperatures of cloud–cloud collisions H_2 is formed and it is shown that a minimum of 3/4 of all interstellar hydrogen atoms are in H_2 molecules. CH+CH+, OH, and CN are produced by chemical exchange in the observed amount when graphite grains are driven at supersonic speeds through the gas by radiation pressure near early type stars. The process predicts the formation of H_2, CO, NH, N_2, from graphite flakes and possibly Platt particles. Author

N66-24407# Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
REGENERATION OF CERAMIC FUELS [REGENERATION DES COMBUSTIBLES CERAMIQUES]
J. Schmets, G. Camozzo, A. Francesconi, R. Heremans, G. Pierini et al Brussels, EURATOM, Mar. 1966 66 p refs
(Contract EURATOM-098-62-11 RDB)
(EUR-2399.f; EURAEC-1479) CFSTI: HC $3.00/MF $0.75

Studies on different reaction sequences usable in the regeneration of ceramic fuels have demonstrated the particular promise of cycles based on the oxidation, hydrofluoridation and fluoridation of uranium and plutonium dioxides. Technological tests were performed in a liquid bed up to a scale of 4 kg of UO_2. There is almost total volatilization of the uranium, in the hexafluoride form. Parallel thermogravimetric tests also showed that the uranium and plutonium could not be separated when fluoridation was carried out with chlorine trifluoride. In this case the residual plutonium would subsequently be converted into hexafluoride by means of fluorine and the majority of fission products thus removed. Studies on the conversion of uranium fluorides into dioxide form, in a molten salt medium, permitted the accurate definition of different parameters governing the production of stoichiometric UO_2. Evidence was provided of the possibilities for the fine separation of uranium and plutonium and the conversion of the latter into the dioxide form by the same method. Author

N66-24424# United Kingdom Atomic Energy Authority, Harwell (England). Information Branch.
BIBLIOGRAPHIC REVIEW OF SELF-DIFFUSION IN METAL OXIDES
P. A. Cumming and P. J. Harrop Oct. 1965 32 p refs
(AERE-BIB-143) HMSO: 4s

A bibliography, with an author index, is given for literature on the determination of self-diffusion coefficients in simple metallic oxides. Publication dates range from 1946 through October, 1965. A table is presented of useful diffusion data, including the frequency factor and the activation energy calculated from the Arrhenius temperature dependence equation for the rate of diffusion. D.T.

N66-24426# Bureau of Mines, Rolla, Mo.
THE THERMODYNAMIC PROPERTIES OF THE ZnO-Fe_2O_3-Fe_3O_4 SYSTEM AT ELEVATED TEMPERATURES (IN TWO PARTS). 1: THE THERMODYNAMIC PROPERTIES AS RELATED TO THE SPINEL STRUCTURE
R. L. Benner and H. Kenworthy 1966 52 p refs
(BM-RI-6754)

The ZnO-Fe_2O_3-Fe_3O_4 system was investigated at 1000°, 1,300°, and 1,400° C, with oxygen pressures between 1.0 and 1×10^{-4} atmospheres. The results, divided into the hydrodynamic properties as related to the spinel structure, and the thermodynamic properties as related to zinc concentrate roasting, were used to calculate the activites of ZnO, Fe_2O_3, and Fe_3O_4 within the spinel solid solution region of the ternary system, and the pseudobinary activities of $ZnFe_2O_4$ and Fe_3O_4. The free energies, the enthalpies, and the entropies of mixing for the binary system were calculated from the binary activities, and the entropies of mixing were compared with two statistical models, one representing an ideal solution, and one representing the mixing of a normal with an inverse spinel. This comparison also indicated that the cations of the components are the major contributing factors to the thermodynamic properties. Author

N66-24430# Bureau of Mines, Pittsburgh, Pa.
FLAMMABILITY CHARACTERISTICS OF TRICHLOROETHYLENE
H. E. Perlee, G. S. Scott, and G. H. Martindill 1966 16 p refs Supersedes BM-RI-6190
(BM-RI-6766; BM-RI-6190)

The concentration limits of flammability and autoignition temperatures of tricholoroethylene in atmospheres of air, oxygen, and nitrogen tetroxide have been determined in a spherical vessel. The autoignition temperatures of TCE in atmospheres of air, oxygen, and nitrogen tetroxide were found to be 419°, 396°, and 221° C, respectively. The flammability zones of TCE-air, TCE-oxygen and TCE-nitrogen tetroxide mixtures at 100° C were found to be 10.5 to 41, 7.5 to 91, and 13.5 to 69 volume percent TCE, respectively. In addition, maximum combustion pressures of 50 psig and 140 psig were recorded for constant volume combustion of the lower limit mixtures of trichloroethylene in air and oxygen, respectively. Author

N66-24465# California Univ., Los Angeles.
THE EFFECT OF PRESSURE ON MELTING Final Report
George C. Kennedy 1966 5 p refs
(Contract Nonr-233(28))
(AD-628975) CFSTI: HC $1.00/MF $0.50

The aim and research goals of this project were those determining the general polymorphism and behavior of the fusion curve of various metallic elements at high pressures and high temperatures. This aim was not simply that of obtaining data but there was the hope of finding some general rules that describe the melting process of metals and sequency of polymorphic behaviors. This has been more successful than anticipated. It was shown in a number of papers that all the Group II elements and the Group III-V elements have essentially identical phase diagrams. Furthermore, this research has shown by analyzing data obtained that the Simon fusion curve does not hold and that a very simple melting relationship $(d\Delta V/V_o)/dT=K$ does hold. TAB

N66-24482# Polytechnic Inst. of Brooklyn, N. Y.
COMPOUNDS WITH DEFECT STRUCTURES Progress Report, Apr. 1–Sep. 30, 1965

E. Banks, M. Greenblatt, E. Kostiner, J. Barshatsky, and V. Abbruscato [1965] 22 p refs
(Contract DA-31-124-ARO(D)-71)
(PR-4)

Least-squares refinement of the crystal structures of the spodiosites, Ca_2CrO_4Cl and Ca_2PO_4Cl has shown that the Cr and P atoms are located in distorted tetrahedral sites, with the CrO_4^{3-} tetrahedron being considerably more distorted. Infrared absorption spectra show evidence of considerably more distortion in the Cr compound. A study of the reaction of LiF and Fe_2O_3 over a wide range of compositions shows the presence of only small amounts of magnetic spinel. A solid solution range nearer to $LiFe_4O_8$ than to the hypothetical composition $LiFe_2O_3F$, is found. These spinels have Curie temperatures about 40° lower than $LiFe_5O_8$. New phases, seemingly analogous to tungsten bronzes, have been found by reaction between NaF and NbO_2. Small single crystals of β-Mn_2O_3, containing variable amounts of Fe and Al, have been grown by anodic oxidation of Mn ions in Na_2WO_4-WO_3 eutectic melts. Single crystals of CdF_2-ZnF_2 with the fluorite structure have been grown at concentrations up to 5% ZnF_2.
Author

N66-24484*# General Atrometals Corp., Yonkers, N. Y.
THE PREPARATION OF ULTRA-FINE BERYLLIUM POWDER BY THE AMALGAM PROCESS
C. O. Gale, V. Griffiths, F. Habashi, and G. T. Hanson Nov. 1965 35 p refs
(Contract NASw-1099)
(NASA-CR-74009) CFSTI: HC $2.00/MF $0.50 CSCL 07A

A pilot plant designed to produce 0.5 lb of micron and submicron beryllium metal powder from commercial $BeCl_2$ per 8-hr shift is described. The process involves the electrolysis of beryllium out of a molten eutectic mixture of $BeCl_2$-NaCl at 300°C, using a mercury cathode and a carbon anode. Separation of the quasi-amalgam formed, recovery of beryllium by pressure removal of the majority of the mercury and vacuum distillation of the residual mercury complete the process.
Author

N66-24494*# National Bureau of Standards, Washington, D. C.
ELECTROCHEMICAL DATA, PART II Quarterly Report, 1 Jan.-31 Mar. 1966
Walter J. Hamer [1966] 412 p
(NASA Order R-09-022-029)
(NASA-CR-74558) CFSTI: HC $7.00/MF $2.00 CSCL 07D

Mean activity coefficients are tabulated by weight and volume from 0 to 100°C for various electrolytes in aqueous solutions. Data, calculated by seven theoretical equations, are presented in 126 tables and are restricted to ionic strengths between 0.0001 and 0.1. Calculations are determined by the limiting law of Debye–Hückel, the Güntelberg equation and its extension, the Davies equation, the Scratchard equation and its extension, and the Bjerrum equation. M.W.R.

N66-24550*# Tyco Labs., Inc., Waltham, Mass.
DEVELOPMENT OF CATHODIC ELECTROCATALYSTS FOR USE IN LOW TEMPERATURE H_2/O_2 FUEL CELLS WITH AN ALKALINE ELECTROLYTE Second Quarterly Report, Oct. 1-Dec. 31, 1965
A. C. Makrides, J. Giner, and R. J. Jasinski [1965] 124 p refs
(Contract NASw-1233)
(NASA-CR-70930) CFSTI: HC $4.00/MF $1.00 CSCL 07D

During this period 58 materials and 10 elements were tested for corrosion resistance and activity as oxygen electrodes in 2 N KOH at 75°C. The technique was used to measure the current potential curve with rotated compact electrodes immersed in KOH solutions saturated with nitrogen or oxygen. Of the tested elements, Pd shows good O_2 activity which is only slightly inferior to Pt. Graphite shows good intrinsic activity and iron with O_2 reduction at E=600 mv is more active than nickel. The experiments with intermetallic compounds show that under conditions of O_2 reduction, the fundamental factor determining the activity is the atomic factor. Compounds of Pt and Au show an i(E) curve for O_2 reduction similar to those of pure Pt and Au. In some cases such as $TaPt_2$, the activity of the intermetallic compound is very close to the activity of pure Pt. The solid solution Co_2Ni shows a behavior which confirms the catalytic activity of Co^{3+} containing oxide and the poor activity of the bivalent oxide. An iron carbide shows better activity for O_2 reduction than Fe. Metallographic characterization of 18 samples of prepared intermetallic compounds shows that where a simple phase was expected, a predominant phase with little or no second phase was obtained. R.N.A.

N66-24558# Bureau of Mines, Salt Lake City, Utah.
RECOVERY OF MANGANESE SULFATE CRYSTALS FROM SOLUTION BY SUBMERGED COMBUSTION EVAPORATION AND BY THERMAL CRYSTALLIZATION
H. C. Fuller 1966 39 p refs
(BM-RI-6762)

Submerged combustion and inverse solubility methods were investigated as promising alternative means for crystallizing manganese sulfate from solutions produced by leaching manganese ores with either sulfuric acid or sulfur dioxide. Evaporation of water from typical manganese sulfate solutions by submerged combustion techniques enabled production of a slurry containing 32 to 39 pct $MnSO_4$-H_2O crystals suspended in a saturated solution of manganese sulfate. Such a slurry required further processing by thickening or filtration and drying to produce crystals of $MnSO_4$-H_2O. In a second approach, semicontinuous processing of manganese sulfate solutions by thermal crystallization under pressure effected a recovery of 94.5 pct of the $MnSO_4$-H_2O as dry free-flowing crystals. Treatment of a solution containing about 100 grams manganese per liter at 189°C, produced a "barren" solution containing only 1.9 grams manganese per liter. Calculations made on comparable manganese sulfate solutions show that the heat requirement of the thermal crystallization method was about one-third to one-fourth that of the submerged combustion method.
Author

N66-24562# Bureau of Mines, Albany, Oreg.
CARBON REDUCTION OF CHROMITE
Williard L. Hunter and Danton L. Paulson 1966 28 p refs
(BM-RI-6755)

A comparative study of the effect of temperature upon the reduction of chromite and ferric oxide by carbon and the relative reducibility of chromites as a function of their composition was carried out. Pellets weighing approximately 1 gram and containing 70 percent ferric oxide, chromic oxide, or chromite and 30 percent graphite were subjected to closely controlled temperatures under a flow of argon for 15 minutes. The amount of CO and CO_2 evolved was measured, and the reduced sample was analyzed by X-ray diffraction techniques. The reduction of Fe_2O_3 was studied over a temperature range of 600° to 1,400°C, while the reduction of Cr_2O_3 and chromite was conducted from 900° to 1,621°C. The temperature above

which appreciable reduction of Cr_2O_3 by graphite took place was 1,125°C. The temperature at which significant reduction started for three of the four chromite samples was approximately the same, indicating that there was concurrent reduction of iron and chromium oxides in the chromite mineral rather than selective reduction of iron oxides followed by reduction of chromic oxide. Rhodesian chromite appeared to dissociate at a lower temperature with concurrent reduction of iron. Statistical analysis of test results indicated that the ferric iron content of chromites affects their reduction behavior more than any other constituent. Author

N66-24675# Bureau of Mines, Bartlesville, Okla. Petroleum Research Center.

CRUDE OIL: QUALITATIVE AND QUANTITATIVE ASPECTS. THE PETROLEUM WORLD

Harold M. Smith 1966 49 p refs

(BM-IC-8286) GPO: $0.50

This report presents a complete qualitative picture of knowledge of the composition of petroleum as of April 1965. The material is presented in detail on two imaginative maps-one, the hydrocarbon hemisphere, depicts the hydrocarbons that have been identified in petroleum; the other, the heterogeneous hemisphere, shows the sulfur, nitrogen, and oxygen compounds that have been found. All compounds are placed on the maps according to boiling point. The accompanying text illustrates by structural formulas the several types of hydrocarbon and nonhydrocarbon compounds identified, presents some quantitative data, and points out the possible geochemical significance of a number of the compounds. The possibilities of the petroleum world of the future are discussed as a function of needed research. Author

N66-24679# Bureau of Mines, College Park, Md.

A COMPUTER PROGRAM FOR ELECTRON PROBE MICROANALYSIS

James D. Brown 1965 35 p refs

(BM-RI-6648)

A computer program in FORTRAN was written to facilitate the calculation of concentrations from X-ray intensities in electron probe microanalysis. Philibert's absorption and Castaing's secondary fluorescence corrections are used; no atomic number correction is included. Background and dead time corrections are applied to the data before calculating the relative intensities. Data from any type of electron probe microanalyzer can be used with the program. Author

N66-24704# Naval Research Lab., Washington, D. C.

STATISTICAL EVALUATION OF GAS CHROMATOGRAPHY FOR THE DETERMINATION OF DISSOLVED GASES IN SEA WATER

V. J. Linnenbom, J. W. Swinnerton, and C. H. Cheek 2 Feb. 1966 20 p refs

(NRL-6344; AD-628916) CFSTI: HC $1.00/MF $0.50

A gas chromatographic method developed by the authors for the determination of dissolved gases in sea water has been evaluated with respect to precision and accuracy by comparison with other methods. Both laboratory and shipboard measurements were employed in the evaluation. Dissolved oxygen analyses made at sea under routine conditions of operation over a period of two weeks indicate statistically significant differences in precision for the three methods tested: gas chromatography (±1.8%), standard Winkler method (±1.0%), and a modification of the Winkler method (±0.51%). No significant bias was bound between gas chromatography and the improved Winkler method. A small but statistically significant bias (−1%) was found for the standard Winkler method relative to the other two. From a practical point of view, these differences are not considered important for routine survey operations. The dissolved N_2 data obtained by gas chromatography are grouped about a mean value of 100% saturation, with approximately 95% of the values falling within (100 ±5%) saturation. The advantages of gas chromatography (routine analyses by relatively nonskilled personnel to obtain simultaneous measurements of more than one gas on a small volume of liquid) are felt to be sufficient to warrant its further use in oceanography. Author (TAB)

N66-24711# Naval Radiological Defense Lab., San Francisco, Calif.

ION EXCHANGE IN FUSED SALTS. II: THE DISTRIBUTION OF ALKALI METAL AND ALKALINE EARTH IONS BETWEEN CHABAZITE AND FUSED $LiNO_3$, $NaNO_3$, AND KNO_3

Clarence M. Callahan 30 Dec. 1965 31 p refs

(USNRDL-TR-970; AD-628997) CFSTI: HC $3.60/MF $0.50

A study was made of the ion-exchange distributions of Na, Ca, K, Ba, Rb, and Cs between the mineral exchanger chabazite and each of the fused salts $LiNO_3$, $NaNO_3$, and KNO_3. The distribution coefficients and the selectivity sequences of the ions varied from salt to salt. The selectivity sequence obtained in fused $LiNO_3$ was taken as the normal one and was in the order of increasing ionic radii of the respective periodic groups. In general the sequence was related to a size-charge effect, and transpositions in this sequence observed in fused $NaNO_3$ and KNO_3 were explained by the influence of the sieving properties of chabazite in depressing the distribution coefficients. In each melt a relationship was found that depended on the size of the chabazite channels, and the operation of a 'two-way traffic' mechanism for ion exchange. In these experiments ion charge was less important than ion size in determining selectivity order. Author (TAB)

N66-24736# Sheffield Univ. (England). Dept. of Chemistry

KINETICS OF THE TRIPLET STATE Final Scientific Report

G. Porter and J. W. Hilpern 30 Sep. 1965 35 p refs

(Contract AF 61(052)-848)

(AFCRL-66-12; AD-628571) CFSTI: HC $3.60/MF $0.50

The quenching efficiency of iodine on triplet naphthalene was examined over a large range of viscosities and a previous observation that it is very efficient was confirmed. The decay of triplet benzophenone was studied and is normal at high viscosities, at low viscosities the ketyl radical is mainly observed. A new triplet band of naphthalene was identified. The intensity of the symmetry forbidden B_{1g} electronic band of biphenyl was calculated. A value a sixth of that observed for the 358 mμ band is obtained suggesting that is possibly part of the B_{1g} band. Author (TAB)

N66-24751# Chicago Univ., Ill. Dept. of the Geophysical Sciences.

EXPERIMENTAL AND THEORETICAL STUDY OF THE ELECTRICAL PROPERTIES OF ICE

Claude Jaccard 1 Feb. 1966 85 p refs Transl. into ENGLISH from Helv. Phys. Acta (Basel), no. 32, 1959 p 89-128

(TN-33)

The electrical properties of the hexagonal phase of ice were experimentally investigated, and a theory involving crystal structure and defects was proposed which permits an interpretation of the results. In contrast to previous theories

treatments, all four types of lattice defects are taken into account simultaneously, and the complex electrical conductivity is computed for the cases of classical and quantum-mechanical proton transfer. The dielectric constant which closely follows a Debye dispersion, the relaxation time, and the high frequency conductivity are determined by the majority defects, (i.e. the kind of defects having highest specific conductivity). In contrast, the conductivity in static fields is determined by the minority defects. If both kinds of defects are balanced, the conductivity and dielectric constant are frequency independent. Analysis of the results leads to the conclusion that the majority mechanism in pure ice crystals is caused by orientational defects. The theoretical value of the mobility of H_3O^+ ions, calculated on the assumption of quantum mechanical proton transfer, is in good agreement with the experimental value of Eigen and De Maeyer. L.S.

N66-24754# Joint Publications Research Service, Washington, D. C.

SYNTHESIS OF HIGH MOLECULAR COMPOUNDS BY THE RADIATION POLYMERIZATION METHOD

V. S. Ivanov 13 Apr. 1966 58 p refs Transl. into ENGLISH from Usp. Khim. (USSR), v. 35, no. 1, 1966 p 93-106
(JPRS-35021; TT-66-31459) CFSTI: $3.00

Details concerning the synthesis of high molecular weight organic compounds by radiation polymerization procedures are given. The following types of starting materials were used: (1) olefinic hydrocarbons, (2) diene hydrocarbons, (3) halogen derivatives of both olefin and diene hydrocarbons, (4) unsaturated carboxylic acids and their derivatives, (5) vinyl esters, (6) vinyl derivatives of both heterocyclic and carbocylic compounds, (7) allyl monomers, (8) acetylene monomers, (9) carbonyl compounds, (10) nitriles of saturated carboxylic acids, (11) isocyanates, (12) cyclical monomers, (13) elemental organic monomers, and (14) inorganic monomers. The advantages and disadvantages of using radiation polymerization as a method of obtaining polymers compared to other methods are noted. Molecular structural formulas are shown throughout the synthetic procedures where applicable. L.S.

N66-24759# Bureau of Mines, Washington, D. C.

ADSORPTION PHENOMENA AND THE REDUCTION OF IRON OXIDES: RELATION OF HEAT OF ADSORPTION TO HEAT OF ACTIVATION FOR THE REDUCTION OF WUSTITE AND MAGNETITE

S. E. Khalafalla, C. W. Schultz, and T. N. Rushton 1965 25 p refs
(BM-RI-6699)

Variations in the activation energy for the carbon monoxide reduction of magnetite and ferrous oxide with respect to the state of aggregation of the oxide material were investigated. Reduction phenomena can only be satisfactorily explained by including an adsorption step in the reduction process. Summation of the values of the exothermic heat of chemisorption and the variable apparent activation energy for reduction yields a nearly constant value of about 50 kcal for either ferrous oxide or magnetite regardless of whether they are aggregated in pelletized form or coarsely crystalline particles. Author

N66-24771# Michigan Univ., Ann Arbor. Dept. of Geology and Mineralogy.

STUDY OF POLYTYPIC PHASE RELATIONS AMONG COMPLEX INORGANIC STRUCTURES Semiannual Report, 1 May-31 Oct. 1965

Donald R. Peacor Ft. Monmouth, N. J., Army Electron. Command, Nov. 1965 11 p refs *Its* Rept.-07325-1-T
(Contract DA-28-043-AMC-01338(E))
(ECOM-01338(E)-1; AD-629438) CFSTI: HC $1.60/MF $0.50

Some polytypic relations between the naturally occurring phases hogbomite, nigerite, taaffeite and sonaite are reviewed. In addition, nigerite is shown to have a unit cell with a and c equal respectively, to 5.79 and 56.20 A. It has a substructure with the lattice type and approximate dimensions of the gahnite spinel structure on which nigerite occurs in oriented overgrowths. Twinning on pseudo-cubic symmetry elements further confirms the close relation between nigerite and gahnite. The polytypic relations among these several oxides are shown to be quite complex and to vary as a function of several compositional and/or structural variables.
Author (TAB)

N66-24781# IIT Research Inst., Chicago, Ill. Technology Center.

DEVELOPMENT OF A RUST-REMOVING CORROSION PREVENTATIVE Final Report, May 21, 1964-May 20, 1965

David B. Boies Aug. 1965 44 p refs
(Contract DA-11-070-AMC-481(W))
(IITRI-C6032-17; AD-626186) CFSTI: HC $2.00/MF $0.50

Removable corrosion preventatives were developed that, when applied to rusted steel or iron surfaces, remove or adsorb the rust during storage and prevent further deterioration. It was necessary to use semipolar wax-base materials in order to provide sufficient rust-removing activity. Fatty amides were used as the wax base in all of the formulations. The rust-removing activity was supplied by materials of an acidic nature, p-toluene sulfonic acid or salicyclic acid, or by chelating agents of the beta-diketone class. The diamide of oleic acid and diethylenetriamine was added as a corrosion inhibitor. The formulations are effective in removing light rust films, and they provide protection against rerusting under inside storage conditions. Author (TAB)

N66-24788# Army Chemical Center, Edgewood, Md. Army Chemical Research and Development Labs.

A FLUOROMETRIC PROCEDURE FOR MEASURING THE ACTIVITY OF DEHYDROGENASES

George G. Guilbault and David N. Kramer Aug. 1965 16 p refs
(CRDLR-3303; AD-622341) CFSTI: HC $1.00/MF $0.50

A simple, direct, fluorometric method is described for measuring the activity of dehydrogenases. The method is based upon the conversion of the nonfluorescent material resazurin to the highly fluorescent compound resorufin, in conjunction with the nicotinamide adenine dinucleotide-reduced nicotinamide adenine dinucleotide (NAD^+-NADH) system. By the procedures described, approximately 0.00010 to 0.1000 unit/ml of lactic acid dehydrogenase, alcohol dehydrogenase, malic acid dehydrogenase, glutamic acid dehydrogenase, glucose6-phosphate dehydrogenase, L-alpha-glycero phosphate dehydrogenase (GPDH), and glycerol dehydrogenase (GDH) may be determined with standard deviations of approximately ±1.0%. Similarly, diaphorase, 0.000400 to 0.0800 unit/ml, resazurin, 0.00000001 to 0.00001 M, and NADH, 0.0000002 to 0.00002 M, may be determined with standard deviations of ±0.5%, ±0.8%, and ±0.5%, respectively.
Author (TAB)

N66-24793# Oklahoma State Univ., Stillwater.
THE MIKER TECHNIQUE
James Edward Bennett (Ph.D. Thesis) May 1965 125 p refs
(Contract AF 33(657)-8767)
(AD-625839) CFSTI: HC $4.00/MF $0.75

A new momentum recoil technique has been developed for determining the vapor pressure and average molecular weight of the high temperature, low pressure vapor species. The Microbalance-Inverted Knudsen Effusion-Recoil technique (the MIKER technique) employs an inverted Knudsen effusion cell with a diverging conical orifice. The construction of a special vacuum microbalance for the Miker technique is described. The average molecular weight of silver vapor at about 1325°K was 62±5 (quartz effusion cell) and 73±5 (graphite cell). The average molecular weight of tin vapor over the range 1332–1540°K was 92±14. The average molecular weight of calcium fluoride vapor over the range 1521–1707°K was 77±7. The vapor pressure of gold from rate of effusion measurements over the range 1533–1673°K yields a least squares solution of log P=7.0184–19964/T. Determinations with a sample-blocked orifice yielded an unexpected logarithmic temperature effect on the recoil force. An analysis is presented which corrects for effusion which occurs during the cooling period of the effusion cell. TAB

N66-24806# Columbia Univ., New York. Radiation Lab.
THE PHYSICS AND CHEMISTRY OF GASES AT HIGH TEMPERATURES Final Report, 1 Nov. 1963–31 Oct. 1965
P. Kusch Nov. 1965 11 p refs
(Grant AF-AFOSR-330-63)
(AFOSR-66-0166; AD-628082) CFSTI: HC $1.00/MF $0.50

An extensive study has been made of the scattering of velocity-selected beams of atomic potassium and potassium chloride by argon and by molecular nitrogen. A detailed investigation of certain hyperfine structures in molecules of deuterated ammonia was made in a beam maser spectrometer. A conventional microwave spectrometer, capable of operation over a wide range of temperatures, was used to study the microwave spectrum of lithium chloride in detail and that of methyl vinyl ether. A reinvestigation of the spectrum of molecular cesium in the optical region was started. The technique of magnetic rotation spectra is being applied to a study of carbon disulfide. TAB

N66-24807# Weizmann Inst. of Science, Rehovoth (Israel).
NEW DETERMINATION OF THE STRENGTH OF THE ν_3 BAND OF WATER VAPOR FROM DISPERSION MEASUREMENTS
M. A. Hirshfeld, J. H. Jaffe, and G. Ross Nov. 1965 13 p refs *Its* Sci. Note No. 4
(Contract AF 61(052)-838)
(AFCRL-66-38; AD-628779) CFSTI: HC $1.60/MF $0.50

The strength of the ν_3 band of water vapor has been redetermined, using the same method as that of Jaffe and Benedict-the measurement of the dispersion of a single line of the band. Improved instrumentation has yielded more accuracy. The final value is S_v=172±7/sq cm/atm at 300K. Author (TAB)

N66-24815# Atlantic Research Corp., Alexandria, Va.
A STUDY OF THE HYDROGEN–FLUORINE REACTION Final Report, 1 Feb. 1962–1 Feb. 1966
Joseph B. Levy Feb. 1966 5 p refs
(Contract AF-49(638)-1131)
(AFOSR-66-0410; AD-628923) CFSTI: HC $1.10/MF $0.50

The research program consisted of the study of the reactions of fluorine and fluorine-like species with hydrogen and other fuel-type molecules. The main effort was directed at the study of the gaseous hydrogen–fluorine system. The thermally-initiated reaction, including the effects of species that inhibit and promote the reaction were investigated. The area of interest also includes the study of fluorine with other species such as hydrocarbons and the study of the reactions of fluorine-like compounds such as oxygen difluoride and tetrafluorohydrazine. The general approach is to study the kinetics of the reactions of these species in order to gain an understanding of the mechanisms of the reactions and of the ways in which species that inhibit or accelerate these reactions exert their effects. Author (TAB)

N66-24828# Rocketdyne, Canoga Park, Calif.
MECHANISM OF ELECTRODE DEMINERALIZATION
John Farrar, Sheldon Evans, and G. D. Steele Washington, Interior Dept., Jan. 1965 49 p refs Sponsored by Interior Dept. *Its* Res. and Develop. Progr. Rept.-126
(PB-166404) CFSTI: $2.00

Demineralization electrodes were studied in half-cells and in complete cells to establish the electrochemical characteristics of individual electrodes and to determine overall polarization characteristics. Polarization data were determined using steady-state techniques, voltammetry at linearly changing potentials, and chronopotentiometry. The carbon paste which gives demineralization properties to Dacron felt was studied as a microelectrode, and the double-layer capacitance was estimated. Author

N66-24833# National Bureau of Standards, Washington, D. C.
RESEARCH ON CRYSTAL GROWTH AND CHARACTERIZATION AT THE NATIONAL BUREAU OF STANDARDS Fourth Biennual Progress Report, Jan.–Jun. 1964
Howard F. Mc Murdie, ed. 19 Oct. 1964 85 p refs
(TN-251) GPO: $0.45

This report summarizes progress on a wide program of studies involving crystalline materials. These include investigation of methods and theory of growth, study of detection and effects of defects, determination of physical properties, refinement of chemical analysis, and determination of stability relations and atomic structure. The types of materials range from organic compounds through metals, and inorganic salts to refractory oxides. The related publications and participating scientists are listed. Author

N66-24840# Bureau of Reclamation, Denver, Colo.
TEST MANUAL (TENTATIVE) FOR PERMSELECTIVE MEMBRANES
Jan. 1964 226 p refs *Its* Res. and Develop. Progr. Rept.-7
(PB-181575) CFSTI: $3.50

This manual presents specified methods for testing, sampling, storing, and shipping permselective membrane materials of both cationic and anionic types. The description of each test method is divided into several sections to aid in their clarity and usability. The tests are presented in accordance with the properties to be measured and not their particular usefulness or importance. There are a variety of permselective membranes available that are fabricated from several resins in a homogeneous form or dispersed in a matrix, with or without the addition of backing or strengthening materials. The main use of permselective membranes is in the electrodialysis process for demineralizing saline water, and the tests presented are intended for use with such membranes. R.N.A.

N66-24856# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

POPULAR SCIENCE (SELECTED ARTICLES)

Pan-ga Lai, Fu-quai Siang, Ho-kuo Yu, and Huang-yin Tsang 25 Oct. 1965 15 p refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 9, 1964 p 812-813, 845 (FTD-TT-65-710/1+2+3+4; AD-475393)

Contents: Investigation of the Paramagnetic Resonance of Anionic Radicals of Aromatic Hydrocarbons. The Magnetic-Core Memory. TAB

N66-24873# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.

PROGRAMMED METHOD FOR DETERMINING CHEMICAL EQUILIBRIUM INCLUDING CONDENSED PHASES [METHODE PROGRAMMEE DE CALCUL DES EQUILIBRES CHIMIQUES AVEC PHASES CONDENSEES]

Bernard Crampel, Simone Barrère, Marie-Paule Lemaitre, and Joëlle Jaubert 1965 152 p refs In FRENCH; ENGLISH summary

(NT-90) CFSTI: HC $5.00/MF $1.00

A general method for the programmation and computation leading to the determination of the equilibirum composition of the products from a chemical reaction including several condensed phases is described. The maximum possibilities of the program are limited to the case of a substance made of 20 elements and which after the reaction gives a total of 250 chemical species in gaseous phase and 20 condensed phases. The present exploitation of the program deals with the 19 following elements: F, Cl, O, N, H, Li, Be, B, C, Na, Mg, Al, Si, Ti, Zr, Tu, S, P as well as a neutral element (He or A). The first part of this note describes the method and gives an account concerning the programmation and its utilization. Some examples permit a familiarization with the different processes and indicate the data necessary for their utilization. In the second part, the description and the detailed working conditions of the program are described. The possibilities and the general organization of the program are given as well as its fractioning and the various precautions which had to be taken before computation. In the last part the FORTRAN vocabulary and the symbolic program are found. Author

N66-24917*# National Aeronautics and Space Administration, Washington, D. C.

CHEMICAL REACTIONS ON THE SURFACES OF GLASS FIBERS USED IN GLASS-REINFORCED PLASTICS [KHIMICHESKIYE REAKTSII NA POVERKHNOSTI STEKLYANNYKH VOLOKON, PRIMENYAYEMYKH DLYA IZGOTOVLENIYA STEKLOPLASTIKOV]

Ye. B. Trostyanskaya, A. M. Poymanov, and A. V. Skorova Apr. 1966 15 p refs Transl. into ENGLISH from Plasticheskie Massy (Moscow), no. 11, 1965 p 67-69

(NASA-TT-F-10099) CFSTI: HC $1.00/MF $0.60 CSCL 07C

The chemical reactions of functional groups on the surface of glass fiber, used as reinforcement for plastics, are reviewed and their interaction with the filler molecules is described. Readily separated ions on the glass fiber surface were replaced by trivalent and tetravalent ions, rendering the fiber hydrophobic and eliminating the retarding action of the hydroxyl ions on the setting of the polycondensation-type binders. This resulted in a tougher plastic with a more resistant surface. Author

N66-24921*# National Aeronautics and Space Administration, Washington, D. C.

THE NATURE OF THE HIGHER SILVER OXIDE [O PRIRODE VYSSHEGO OKISLA SEREBRA]

A. B. Neyding and I. A. Kazarnovskiy Apr. 1966 13 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 78, no. 4, 1951 p 713-716

(NASA-TT-F-10110) CFSTI: HC $1.00/MF $0.50 CSCL 07B

The magnetic susceptibility of certain physiochemical properties of the AgO is studied. It is found that this oxide is diamagnetic, and that the anomaly of the AgO magnetic properties is caused by specific features of the crystalline lattice of this oxide. Author

N66-24957*# Florida Univ., Gainesville. Engineering and Industrial Experiment Stations.

A STUDY OF GAS SOLUBILITIES AND TRANSPORT PROPERTIES IN FUEL CELL ELECTROLYTES First Semiannual Report, 1 Sep. 1965-28 Feb. 1966

Robert D. Walker, Jr. 15 Mar. 1966 57 p refs

(Grant NGR-10-005-022)

(NASA-CR-74779) CFSTI: HC $3.00/MF $0.50 CSCL 07D

During this period experimental methods were developed for measuring the density and vapor pressure of KOH solutions, and the solubility of O_2 and H_2 in KOH solutions over the required range of conditions. Experimental measurements of density and vapor pressure were made for KOH concentrations in the 0 to 32% range and for temperatures up to 70°C. Work began on developing an experimental method for determining diffusion coefficients of oxygen and hydrogen in KOH solutions. A literature search was made for values of density and vapor pressure, and the values for the solubility of oxygen and hydrogen in KOH solutions. The results of the survey are included in the appendix. R.N.A.

N66-25068# Technische Univ., Berlin (West Germany).

REACTION BETWEEN PHOSPHORUS TRICHLORIDE AND OLEFINS UNDER THE INFLUENCE OF GAMMA-RAYS AND HEAT [REAKTIONEN ZWISCHEN PHOSPHORTRICHLORID UND OLEFINEN UNTER DEM EINFLUSS VON GAMMA-STRAHLUNG UND VON WARME]

Klaus Wunder (Ph.D. Thesis) 3 Jun. 1965 70 p refs In GERMAN

(NP-15539)

Radioinduced reactions between phosphorus trichloride and olefin hydrocarbons were studied. The effect of γ radiation on mixtures of phosphorus trichloride and cyclohexene or hexene-1 formed 1-chlorcyclohexyl phosphorus dichloride or 2-chlorhexyl phosphorus dichloride by a Kharasch chain reaction mechanism. Under optimum conditions 100 to 2000 ev yields can be obtained. This method is suitable for the preparation of compounds. The G value is proportional to the reciprocal square root of the dose output and attains in both cases a maximum in 100°C in mixtures of 30 vol % olefin and 70 vol % phosphorus trichloride. For the activation energy of the velocity-determining steps $PCl_2C_6H_{10}+PCl_3 \rightarrow PCl_2C_6H_{10}Cl+PCl_2$ or $PCl_2C_6H_{12}+PCl_3 \rightarrow PCl_2C_6H_{12}Cl+PCl_2$ values of 7 or 6.6 kcal/mole were found. At higher temperatures, the yield decreases sharply since another chain reaction predominates, through which cyclohexyl phosphorus dichloride or n-hexyl phosphorus dichloride was formed. Both chains have a common growth step. A reaction scheme was formulated that clarifies the details of the reactions. Author (NSA)

N66-25073# Polytechnic Inst. of Brooklyn, N. Y.
COLOR-FORMING DOSIMETERS FOR IONIZING RADIATION Final Report, 1 Jun. 1958-31 Jan. 1965
Gerald Oster 13 Dec. 1965 92 p refs
(Contract AT(30-1)-2206)
(NYO-2206-1) CFSTI: HC $3.00/MF $0.75

Information is given on: thiolated gelatin as a model biological substrate; organic phosphorescent materials; environmental factors in luminescence and photoconductivity of zinc oxide; zonc oxide-sensitized photochemical reduction and oxidation; zinc oxide-sensitized photopolymerization; dye-sensitization and desensitization in zinc oxide photoconductivity; and zinc oxide as a radiation dosimeter. NSA

N66-25079# National Lead Co. of Ohio, Cincinnati.
APPLICATION OF ATOMIC ABSORPTION TO THE DETERMINATION OF SOME ELEMENTAL IMPURITIES IN URANIUM-BASED SAMPLES AND MAGNESIUM METAL
M. L. Jursik and J. F. Werdmann 8 Sep. 1965 21 p ref Presented at 15th Ann. Natl. Lead Co. Anal. and Phys. Testing Symp., Hightstown, N. J., 14–15 Oct. 1965
(Contract AT(30-1)-1156)
(NLCO-964; CONF-651029-3) CFSTI: HC $1.00/MF $0.50

Atomic absorption spectrophotometry was applied to the determination of iron and nickel in uranium trioxide and magnesium in uranium metal. The technique is rapid and precise. Atomic absorption was also used to confirm cadmium values in magnesium that were obtained by emission spectroscopy. Iron in the range of 20 to 60 ppM, uranium basis, is extracted from a hydrochloric acid solution of uranium trioxide into methyl isobutyl ketone. The organic containing the iron is aspirated into the flame without separation from the aqueous layer. Nickel in uranium trioxide in the range of 3 to 20 ppM is determined by the direct aspiration of a hydrochloric acid-methyl alcohol solution of the sample. The concentration of uranium in the solution is 4%. Magnesium in the range of 40 to 200 ppM in reactor grade uranium metal is determined by the direct aspiration of a hydrochloric acid solution containing 2% uranium. Cadmium in cut-crown magnesium is determined in the range of 0.2 to 1.0 ppM. Cadmium is separated from the magnesium as the sulfide, redissolved in nitric and perchloric acids, and aspirated into an air-hydrogen flame.
Author (NSA)

N66-25123# Iowa State Univ. of Science and Technology, Ames. Inst. for Atomic Research.
MASS SPECTROMETRY OF VOLATILE INORGANIC COMPOUNDS
Harry J. Svec 1 Nov. 1965 31 p refs Presented at the Inst. in Mass Spectrometry, Glasgow; Sponsored by NATO Submitted for Publication
(Contract W-7405-ENG-42)
(IS-983; CONF-640812-1) CFSTI: HC $2.00/MF $0.50

Results on mass spectra of volatile inorganic halides, metal carbonyls, and hydrides are reported, and problems associated with the measurements are discussed. It was concluded that the application of appearance potential data to calculating thermochemical properties of inorganic compounds, not amenable to calorimetric measurements, can be on firm ground if enough is known about all of the parameters involved in an appearance potential value. NSA

N66-25138# California Univ., Berkeley. Lawrence Radiation Lab.
ISOMERIC CHEMICAL SHIFTS AND ELECTRONEGATIVITY
David A. Keller (M.S. Thesis) Oct. 1965 33 p refs
(Contract W-7405-ENG-48)
(UCRL-16436) CFSTI: HC $2.00/MF $0.50

Mössbauer experiments were carried out at 4.2°K using ^{197}Au and ^{119}Sn as solutes in dilute binary alloys to study the relationship, if any, between the isomeric chemical shift and the difference in electronegativity between the solvent metal and the Mössbauer element. ^{197}Au was embedded into nineteen host lattices and the resulting isomeric chemical shifts on the Mössbauer resonance did show a positive correlation between the chemical shift and electronegativity. However, similar experiments using ^{119}Sn as the Mössbauer solute in six metallic lattices failed to show any correlation at all between chemical shift and electronegativity.
Author (NSA)

N66-25206# Argonne National Lab., Ill.
CONSOLIDATION OF LANTHANON FISSION PRODUCTS IN ALLOYS
J. B. Knighton, R. A. Mancini, and R. K. Steunenberg Aug. 1965 48 p refs
(Contract W-31-109-ENG-38)
(ANL-7064) CFSTI: HC $1.00/MF $0.50

The feasibility of extracting the lanthanon elements from a molten chloride salt into binary magnesium alloys which could serve as a medium for both interim and permanent disposal, and possibly as a useful source of heat and activity, was investigated. The salt composition selected was the ternary system 50 mole % $MgCl_2$-30 mole % NaCl-20 mole % KCl (mp 396° C). Distribution coefficients of praseodymium, a representative lanthanon fission product, were determined between the molten salt and liquid binary alloys of magnesium with aluminum, copper, lead, antimony, and nickel. The most favorable distribution coefficients were obtained with the magnesium–aluminum system. Distribution coefficients of yttrium, lanthanum, cerium, and praseodymium between the salt and magnesium–aluminum alloys were determined, and their solubilities in the liquid-metal phase were measured at various temperatures and magnesium concentrations. The results indicated that an aluminum–20 wt% magnesium alloy provides excellent removal of lanthanons from the salt in a single-stage extraction. The technique also appears to be applicable to fission product oxide and fluoride wastes, and to the consolidation of noble and refractory metal fission products, as well as lanthanons, in metallic alloys.
Author (NSA)

N66-25208# California Univ., Livermore. Lawrence Radiation Lab.
APPARATUS FOR AUTOMATIC PREPARATIVE GAS CHROMATOGRAPHY
J. W. Frazer and C. J. Morris 6 Dec. 1965 30 p
(Contract W-7405-ENG-48)
(UCRL-14359) CFSTI: HC $1.00/MF $0.50

A valveless system for compound purification by chromatographic techniques is described, and operational data are given. The sample injection system is pneumatically operated. An inert gas pressure applied for a preset time forces the sample from a reservoir through a capillary needle onto the chromatographic column. By the proper adjustment of the three parameters involved a sample can be admitted in near plug condition. All valves and other moving mechanisms are eliminated from the area between the column exit and the collection traps. This allows the necessary temperature control without the risk of leaks. Trap selection is by means of automatic valves located at the exits of the traps. These valves direct the carrier gas path through the various traps. The trapping logic is programmable. The adjustable parameters are time and detector signal. Author (NSA)

N66-25234# Union Carbide Nuclear Co., Oak Ridge, Tenn.
DETERMINATION OF METALLIC IMPURITIES IN ALUMINUM BY X-RAY FLUORESCENCE
C. A. Kienberger and A. R. Flynn 14 Jan. 1966 27 p refs
(Contract W-7405-ENG-26)
(K-1638) CFSTI: HC $2.00/MF $0.50

An X-ray fluorescence method was developed for process control measurement of uranium in aluminum being decontaminated in a salt bath furnace, and for determining uranium, magnesium, silicon, barium, chromium, manganese, iron, nickel, copper, and zinc in the cast aluminum ingots. Homogeneous samples were obtained by pouring the molten aluminum into a special mold to form a flat disk. Uranium concentrations as low as 2 ppM in aluminum can be detected. Relative standard deviations of ±5% were obtained for single measurements of uranium at the 200 ppM level, magnesium at the 2% level, and the other metallic impurities at concentrations of 0.5%. A determination of any one of the above ten elements can be made in less than 10 minutes.
Author (NSA)

N66-25254# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Advanced Development Program.
A RAPID RADIOMETRIC SULFATE ANALYSIS
G. Pescatore and D. J. Becker Sep. 1965 26 p refs
(ADN-09-08-65.1)

The purpose of this investigation was to develop a rapid and accurate method for the quantitative analysis of sulfate. A radiometric technique was developed and used in controlling nitric-sulfate deoxidizer baths. Radioactive barium-133 chloride was used to precipitate the sulfate in an aliquoted sample as barium-133 sulfate. Excess barium-133 chloride in the filtrate was then measured with a scintillation spectrometer, and expressed as the sulfate concentration. Ten samples were analyzed in an hour and a half using this procedure. This technique can be adapted for any sulfate determination, in any system.
Author

N66-25269# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
PRESSURE DEPENDENCE OF INTERSTITIAL-SUBSTITUTIONAL DISSOCIATIVE DIFFUSION
T. R. Anthony, B. F. Dyson, and D. Turnbull Jan. 1966 16 p refs
(Contract ARPA SD-88)
(ARPA-21; AD-630457) CFSTI: HC $1.00/MF $0.50

The pressure dependence of the diffusivity of a solute existing in a substitutional–interstitial equilibrium is derived for the case where the interstitial solute's diffusion constant is much larger than its substitutional diffusion constant. The results, applied to the diffusivity of silver and gold in lead, show that these solutes dissolve almost completely interstitially in lead.
Author (TAB)

N66-25295# Joint Publications Research Service, Washington, D. C.
THE SYNTHESIS OF DIALKYL TRIORGANOSILYLMETHOXYMETHYL PHOSPHINATES AND THEIR HYDROLYTIC STABILITY
N. F. Orlov and V. P. Mileshkevich 18 Feb. 1966 11 p refs
Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 164, no. 2, 1965 p 344–346
(JPRS-34199; TT-66-30640) CFSTI: $1.00

This work describes the synthesis of a new class of silicon–phosphorus organic compounds. They are esters of triorganosilylmethoxymethyl phosphinic acids, in which the silicon and phosphorus are potentially stable to hydrolysis with a simple ester grouping. These compounds were obtained by reaction of chloromethyltriorganosilanes with dialkyl sodium oxymethylphosphinates.
R.N.A.

N66-25298# Bureau of Mines, Pittsburgh, Pa. Diesel Test and Research Section.
DETERMINATION OF OXIDES OF NITROGEN IN DIESEL EXHAUST GAS BY A MODIFIED SALTZMAN METHOD
Rogers F. Davis and William E. O'Neill 1966 13 p refs
(BM-RI-6790)

A new method was developed for the determination of oxides of nitrogen in diesel exhaust gas. The procedure, a modification of the Saltzman method, uses a NO_2 absorbent for the diesel exhaust gas; the colorless absorbant becomes purple on contact with NO_2. When used properly this procedure gives satisfactory results in 2 hours, whereas the standard phenoldisulfonic acid method required approximately 8 hours. The new method is not satisfactory for determination of oxides of nitrogen in the overrich fuel to air ratio range.
Author

N66-25300# National Bureau of Standards, Washington, D. C. Inst. for Basic Standards.
SELECTED VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES. PART 1: TABLES FOR THE FIRST TWENTY-THREE ELEMENTS IN THE STANDARD ORDER OF ARRANGEMENT
Donald D. Wagman, William H. Evans, Iva Halow, Vivian B. Parker, Sylvia M. Bailey et al 1 Oct. 1965 143 p refs
(NBS-TN-270-1) GPO: $0.65

Tables of thermodynamic properties for the first 23 elements in the standard order of arrangement are presented. The tables contain values of the enthalpy and Gibbs energy of formation, enthalpy, entropy, and heat capacity at 298.15°K (25°C), and the enthalpy of formation at 0°K, for all inorganic substances and organic molecules containing not more than two carbon atoms. In some instances, such as metal-organic compounds, data are given for substances in which each organic radical contains one or two carbon atoms.
R.N.A.

N66-25313# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 236
Wei-wei Hsiao and Chung-ho Shen 10 Nov. 1965 53 p refs
Transl. into ENGLISH from Hua-hsueh T'ung-pao (Peiping), No. 11, 14 Nov. 1964 p 22–23, 43–49
(JPRS-32798; TT-65-33376) CFSTI: $3.00

CONTENTS:
1. THE CHEMISTRY OF POLYFORMALDEHYDE Wei-wei Hsiao p 1–34 refs
2. PROGRESS IN INTERFACIAL POLYCONDENSATION Chung-ho Shen p 35–49 refs

N66-25320*# Western Ontario Univ., London. Molecular Excitation Group
IDENTIFICATION ATLAS OF MOLECULAR SPECTRA. 3: THE N_2^+ B $^2\Sigma_u^+ - X\ ^2\Sigma_g^+$; FIRST NEGATIVE SYSTEM OF NITROGEN
D. C. Tyte and R. W. Nicholls Apr. 1965 35 p refs
(Grant NSG-349; Contract AF 19(628)-2820; Grant AF-AFOSR-62-236A)
(NASA-CR-74950) CFSTI: HC $2.00/MF $0.50 CSCL 07D

This report contains a set of vibrationally identified spectrograms of the First negative system of ionized nitrogen (N_2^+ $B\ ^2\Sigma_u^+$–$X\ ^2\Sigma_g^+$). A compilation of all the available molecular data on the states involved; a brief description of the appearance, occurrence, and history of the system; and a selected bibliography are also included. Author

N66-25328# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
AUTOMATED ANALYSIS OF LITHIUM SOLUTIONS
Rufus H. Gaddy Oct. 1965 15 p refs
(Contract AT(07-2)-1)
(DP-985) CFSTI: HC $1.00/MF $0.50

An automated flame photometric method was developed for the precise determination of lithium in highly radioactive process solutions containing curium, americium, and fission product radionuclides. Author (NSA)

N66-25333# Oak Ridge National Lab., Tenn.
LABORATORY PREPARATION OF URANIUM NITRIDE MICROSPHERES BY A SOL-GEL TECHNIQUE
T. A. Gens, D. M. Helton, and S. D. Clinton Nov. 1965 27 p refs
(Contract W-7405-ENG-26)
(ORNL-3879) CFSTI: HC $2.00/MF $0.50

Methods were successfully developed for preparing urania–carbon sols and converting these sols into gel microspheres. Two methods were investigated for converting the gel microspheres into UN microspheres: heating the gel microspheres in nitrogen to produce uranium nitride directly; and heating in argon to produce uranium carbide, then in nitrogen to produce uranium nitride from the carbide. Both methods appear promising. The second method always yields a product containing carbon. Author (NSA)

N66-25339# Los Alamos Scientific Lab., N. Mex.
A MASS SPECTROMETRIC STUDY OF THE VAPOR PRESSURE OF $U_{(g)}$ AND $UC_{2(g)}$ OVER VARIOUS COMPOSITIONS IN THE URANIUM-CARBON SYSTEM
Edmund K. Storms [1965] 35 p refs Presented at the IAEA Symp. on Thermodyn., Vienna
(Contract W-7405-ENG-36)
(LA-DC-6953; CONF-650704-10) CFSTI: HC $3.00/MF $0.50

The pressure of $U_{(g)}$ and $UC_{2(g)}$, and the resulting partial heats of vaporization of $U_{(g)}$ and $C_{(g)}$, were measured as a function of composition from $UC+U_{(l)}$ to UC_2+C. An abrupt pressure change with composition was found near $UC_{1.0}$ and of vaporization of $U_{(g)}$ at ~2200° K shows a similar rapid change in value through $UC_{1.0}$ with a maximum near $UC_{1.2}$ at 167 ±2 kcal/mole. Another maximum occurs in the UC_2 region at 147 ±2 kcal/mole and $UC_{1.85}$. The heat of vaporization based on the UC_2+C region is too low since the UC_2 phase changes composition with temperature. The measured pressures are consistent with congruent vaporization near $UC_{1.1}$. Evidence is presented supporting a value for the heat of vaporization of uranium near 126 kcal/mole. Using this value, the measured pressures in the U–C system show excellent agreement with the other thermodynamic measurements. A re-evaluation was made of the high temperature thermal functions of U, UC, and UC_2 with the result that significant changes must be made in the currently used values. Several areas of the phase diagram were determined both directly and from the pressure measurements and are compiled into a phase diagram of the system. Author (NSA)

N66-25343# Brookhaven National Lab., Upton, N. Y.
CHEMICAL CRYSTALLOGRAPHY
Walter C. Hamilton Aug. 1965 24 p refs *Its* Lecture Ser., No. 47, 12 May 1965
(Contract AT(30-2)-GEN-16)
(BNL-930(T-384)) CFSTI: HC $1.00/MF $0.50

The use of molecular structure in determining crystal structure is discussed. Experiments and examples are cited. NSA

N66-25347# California Univ., Berkeley. Lawrence Radiation Lab.
THE CALCULATION OF VAPOR-LIQUID-EQUILIBRIA FROM AN EQUATION OF STATE
J. A. Hoiberg Sep. 1965 65 p refs
(Contract W-7405-ENG-48)
(UCRL-16407) CFSTI: HC $3.00/MF $0.50

A complete equation of state for the gaseous and liquid phases contains implicitly a description of the vapor-liquid equilibrium. An equation of state (ES64) previously suggested was used for a computer program predicting pressure and vapor composition when the temperature, the liquid composition, and three parameters (required by the equation of state) for each component are given. The results obtained were compared with literature data for a number of binary and ternary systems. Author (NSA)

N66-25348# California Univ., Livermore. Lawrence Radiation Lab.
RADIOCHEMICAL PURIFICATION PROCEDURES FOR THE ELEMENTS
Manfred Lindner, comp. 13 Jul. 1965 116 p refs
(Contract W-7405-ENG-48)
(UCRL-14258) CFSTI: HC $4.00/MF $1.00

Radiochemical procedures, developed by various experimenters at the Lawrence Radiation Laboratory in Livermore, are described for the purification of 48 individual elements from complex mixtures of radioactive species, preponderantly fission products. The degree of purification and the time required to perform the separations are given. Author (NSA)

N66-25349# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
ANALYSIS OF AMERICIUM FOR PLUTONIUM, THORIUM AND RARE EARTH IMPURITIES BY EMISSION SPECTROSCOPY
H. N. Barton 27 Oct. 1965 32 p refs
(Contract AT(29-1)-1106)
(RFP-414) CFSTI: HC $2.00/MF $0.50

Parts per million impurity concentrations of plutonium, thorium, and rare earth elements in americium were determined by an optical emission spectrographic method after their separation by ion exchange. Plutonium and thorium were separated by adsorption of their nitrate complexes on an anion exchange column and determined by a photometric procedure. Rare earths were separated by a thiocyanate anion exchange column and determined by visual comparison with standard spectra. Author (NSA)

N66-25361# Oak Ridge National Lab., Tenn.
A METHOD FOR PURIFICATION AND GROWTH OF KCl SINGLE CRYSTALS

C. T. Butler, J. R. Russell, R. B. Quincy, Jr., and D. E. La Valle
Feb. 1966 46 p refs
(Contract W-7405-ENG-26)
(ORNL-3906) CFSTI: HC $2.00/MF $0.50

A method is described by which large, uniform KCl crystals of high purity can be obtained, starting with reagent grade material. Chemical means were employed to produce pure polycrystalline ingots which were then used to grow single crystals by pulling from the melt under semi-clean room conditions. The resulting crystals contain less than 1 μg/g of any foreign alkali or halide element, show OH− concentrations of less than 10 ppB and conductivity knees which indicate typically less than 300 ppB total heterovalent cation content. Analytical methods are discussed and analyses of these as well as crystals from various commercial sources are given. Author (NSA)

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N66-23895# Delaware Univ., Newark. Dept. of Electrical Engineering.
MAXIMIZATION OF TRANSINFORMATION IN PHOTODETECTION
John C. Murray, Jr. Jun. 1965 62 p refs
(Grant AF-AFOSR-2-65)
(Q-51; AFOSR-66-0309; AD-628807) CFSTI: HC $6.60/MF $0.75

A photodetector is considered as a communication channel and a study made of the maximum information per degree of freedom I which can be transmitted through the channel. Application of the calculus of variations yields a necessary equation which the input probability must satisfy when I is a maximum. It is found that for large average signal energy this necessary equation is satisfied when the input signal energy has an exponential probability density. The dependence of I on average signal energy with an input probability of this maximizing form is calculated numerically. Author (TAB)

N66-23929# Navy Underwater Sound Lab., New London, Conn.
THE QUASI-STATIC FIELDS OF DIPOLE ANTENNAS, PART III
Peter R. Bannister and William C. Hart 23 Feb. 1966 19 p refs
(USL-720; AD-629620) CFSTI: HC $1.60/MF $0.50

The electric and magnetic field components produced by vertical and horizontal magnetic dipoles are presented for the quasi-static range of (free space propagation constant x ρ)<<1< (earth propagation constant x ρ) with (free space propagation constant x z)<<1, h=0, and z>or =0. The special case of burying the transmitting dipole (h<or=0) is also considered. This range has been considered by many writers, but with the restriction that $\rho >> z$. In this report, the authors evaluate the previously underived (to the authors' knowledge) components that are valid for any height z (neglecting ionospheric effects). Author (TAB)

N66-23941# Lincoln Lab., Mass. Inst. of Tech., Lexington.
STATISTICAL METHODS FOR THE ANALYSIS OF RE-ENTRY VEHICLE RADAR DATA, PART I
Leland A. Gardner, Jr. 13 Jan. 1966 102 p refs *Its* Tech. Note-1966-5
(Contract AF 19(628)-5167)
(ESD-TDR-66-11; AD-629359) CFSTI: HC $10.60/MF $0.75

This report treats the theoretical problem of joint estimation of the wake and hard body cross sections (the parameters of the Rice distribution) from either incoherent or coherent radar data. Author (TAB)

N66-23960# Naval Ordnance Lab., Corona, Calif. Research Dept.
BROAD-BAND VLF TRANSMITTING TERMINATED DIPOLE
Elwin W. Seeley 7 Feb. 1966 22 p refs
(NOLC-638; AD-629353) CFSTI: HC $1.00/MF $0.50

The need is cited for an efficient, easily constructed broad-band VLF transmitting antenna for ionospheric and other research. A multiconductor horizontal dipole is investigated experimentally and theoretically. The radiated E-field equations are derived for the terminated dipole, and field-strength measurements made out to 1400 km confirm the equations. Two such dipoles (a 5-conductor over soil of 16 mmho/m conductivity, and another with 10 conductors over a lava bed of 0.8 mmho/m conductivity) were constructed in the California desert. Measurements made yielded design data: Impedance measurements to obtain propagation constants, bandwidth, attenuation per unit length, and mutual and characteristic-impedances. Methods of improving efficiency of the horizontal dipole are discussed. Author

N66-23974# Aerospace Corp., San Bernardino, Calif.
COMPUTER STUDY OF A DIVERSITY AUGMENTED, VEHICULAR, RADIO COMMUNICATION SYSTEM IN A MANMADE NOISE ENVIRONMENT Technical Report, 1 Jan.–31 Dec. 1965
Edward N. Skomal and Kenneth C. Reed Feb. 1966 27 p refs
(Contract AF 04(695)-669)
(TR-669(S6951-24)-3; BSD-TR-66-60; AD-629584) CFSTI: HC $2.60/MF $0.50

The communication performance in the presence of manmade interference of a multiple terminal, diversity augmented, vehicular, radio relay communication system dispersed throughout a large geographical area has been studied by computer modeling of the multinode system. The radio relay system operating at UHF in the presence of unintentionally generated manmade ratio noise has been evaluated from the viewpoint of message propagation rate and completeness of coverage for varying relay point distributions. The communication performance for several distributions of mobile relays dispersed in a specified-operational area of western Europe was examined under the influence of manmade UHF noise generated by 52 urban industrial centers in the region. The effectiveness of message repetition in overcoming the adverse effect of intense manmade noise was measured as a function of relay point density. Author (TAB)

N66-23976# Navy Underwater Sound Lab., New London, Conn.
LOW FREQUENCY SHIELDING OF A CIRCULAR LOOP ELECTROMAGNETIC FIELD SOURCE
J. Ronald Moser 26 Jan. 1966 54 p refs
(USL-716; AD-629005) CFSTI: HC $5.60/MF $0.50

The problem of low frequency shielding of a loop axially perpendicular to a plane shield of infinite extent is analyzed by (1) the thin shield work of Samuel Levy, (2) solution of the vector wave equation, and (3) application of the transmission theory of shielding of S. A. Schelkunoff. Experimental data are obtained and compared with results of techniques (1) and (3) in the frequency range 100 cps to 50 kc. The first analytical technique is not general, and the limits of applicability of the results are discussed. In the second solution, which is general, expressions are derived for the total electric and magnetic fields on both sides of and within the shield. The resulting expression for shielding effectiveness is not solved because of its complexity. The results of the third theory are adapted to the problem. The shielding effectiveness expression s=r +a+b is computer evaluated for the six shields considered (1/16-inch and 1/8-inch thick aluminum, copper, and steel). Although some approximations are made, this analytical method is the most useful in predicting the insertion loss of the shield, since the theory includes those parameters neglected in the first analytical technique. Author (TAB)

N66-24116*# Harvard Univ., Cambridge, Mass. Gordon Mc Kay Lab.

RADIATED POWER AND OHMIC LOSS OF THE INFINITELY LONG CYLINDRICAL ANTENNA Scientific Report No. 6

Liang-chi Shen and Tai-tsun Wu Feb. 1966 24 p refs (Grant NsG-579)

(NASA-CR-74226) CFSTI: HC $1.00/MF $0.50 CSCL 09F

The input conductance of an infinite antenna formed by a cylindrical tubular conductor of internal impedance z^i is obtained, together with the ohmic loss and the radiated power which contribute to the input conductance. It is found that the ohmic loss on the antenna behaves like $1/[\log|1z^i|]$ for small z^i, rather than a small perturbation of order z^i. Several conclusions may be drawn: (1) The infinite antenna with zero internal impedance is of very different character from that with non-vanishing z^i, even when z^i is quite small; (2) The present theory may be verified experimentally with an antenna of finite length provided the internal impedance is not too low; (3) In the theory of the very long antenna the internal impedance is not negligible for all practically available metals. A brief qualitative discussion of the very long antenna is given to indicate the need for further study on that subject. Author

N66-24121*# Hughes Aircraft Co., Culver City, Calif. Antenna Dept.

STUDY OF SPACECRAFT ANTENNA SYSTEMS Interim Engineering Report (Final), Oct. 1963-Jan. 1965

W. H. Kummer and A. T. Villeneuve [1965] 263 p refs (Contract NAS5-3545)

(NASA-CR-71797; P65-35) CFSTI: HC $6.00/MF $1.00 CSCL 09F

An antenna systems study for spacecraft communications was performed that included a literature review, a field survey, and an assessment of the state-of-the-art in electronic beam formation shaping and steering techniques. Multiple-beam formation methods, phased-locked loops, electronically scanned antenna systems, electronically self-steering antenna systems, and millimeter-wave antenna systems are discussed. Several implementations of beam forming and shaping are included. Among these are diode-iris control of the amplitude and phase of slot radiation, a multibeam-forming transdirective array, amplitude scanning by time-control synthesis, a mechanically scanned millimeter-wave cylindrical lens system, and a multibeam Luneberg lens antenna with a mosaic feed. A survey of electronic and mechanical steering for the millimeter wavelengths (to 100 Gc) is also included. Components for the implementation of the various antenna systems are described and include standard and miniature ferrite phase shifters, semiconductor variable capacitance and PIN diode phase shifters, and log-periodic circuits. Where techniques are critically dependent upon certain components, these critical component areas are identified and are assessed for the appropriate applications. Author

N66-24134# Joint Publications Research Service, Washington, D. C.

THE ANALYSIS OF SIGNS FOR RECOGNITION OF SPEECH

Ye. T. Semenova *In its* Bionics 20 Apr. 1966 p 60-66 (See N66-24126 13-04) CFSTI: $9.10

Photographs are presented of oscillograms of vowel and consonant sounds taking in the course of an analysis of signs for recognition of speech. A spectral analyzer was used to determine the make-up of the sounds, and controlled analysis of the frequency spectrum was performed by a computer. The ordinary signal (unclipped) without distortion appears to have a spectrum which coincides with that of a clipped signal; and this is considered to explain the high discrimination of so-called clipped speech. On the basis of these preliminary analyses, a device was constructed to recognize vowel sounds; analysis indicates that while the device can recognize sounds by one announcer, it cannot be used as a recognition device which will permit recoding from any voice. A device was also developed to investigate combinations of vowel and concordant sounds. Again, it appears to be best for the recognition of one voice; it does not recognize phonemes. M.W.E.

N66-24165# Joint Publications Research Service, Washington, D. C.

ON ACOUSTICAL COMMUNICATION SIGNALS

V. R. Protasov *In its* Bionics 20 Apr. 1966 p 316-322 refs (See N66-24126 13-04) CFSTI: $9.10

Results are reported for studies dealing with the range of acoustical signalling in fish to denote spawning, danger, and presence of food. Signals related to spawning are reported to be carried as far as 50 meters, whereas the sounds emitted during fights and while guarding nests are said to carry only 1.0 to 1.5 meters. In an aquarium, the sounds of eating are carried only 0.5 to 1.0 meters. Acoustically, properties of these signals are found to be different; for example, wideband frequencies and low intensity sounds are emitted during eating, whereas spawning signals are in a narrow band of frequencies which is completely resonant and the intensity is considerably higher than for the eating signals. It is pointed out that fish may hear sounds and not react to them; that is, the acoustical signal must be accompanied by a visual signal for a reaction to occur. Another study is noted in which the sound of eating is detected both by fish and by men equipped with special instruments, even when the signals are in a noisy environment. It is suggested that the rhythmic structure of spawning signals used by fish for long distance communication is noise resistant. M.W.E.

N66-24306# Joint Publications Research Service, Washington, D. C.

STUDIES IN AUTOMATION AND TELEMECHANICS

18 Mar. 1966 46 p refs Transl. into ENGLISH from Avtomat. i Telemekh. (Moscow), v. 26, no. 12, Dec. 1965 p 2214-2238

(JPRS-34608; TT-66-31047) CFSTI: $2.00

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N66-24307# Joint Publications Research Service, Washington, D. C.

THE PROBLEM OF OPTIMIZING THE STRUCTURES OF INFORMATION NETWORKS

V. V. Kiryukhin *In its* Studies in Automation and Telemech. 18 Mar. 1966 p 1–12 refs (See N66-24306 13-07) CFSTI: $2.00

Algorithms are presented for computing the optimal reliability of radial structure communications networks in the case of arbitrary reliability of reserve channels. The conditions of variable nonnegativity are retained in the formulation of the problem. D.T.

N66-24308# Joint Publications Research Service, Washington, D. C.

MODELING PROCESSES OF INFORMATION PROCESSING IN THE NEURON. II: PRINCIPLES OF CONSTRUCTING A NEURON MODEL PERFORMING ELEMENTARY MATHEMATICAL OPERATIONS

I. A. Lyubinskiy and N. V. Pozin *In its* Studies in Automation and Telemech. 18 Mar. 1966 p 13–26 refs (See N66-24306 13-07) CFSTI: $2.00

Modern theories of the role of the dendrites in the work of the neuron are presented. It is stressed that if the interaction between input signals in the dendrites is taken into account, then it is possible to assume that the neuron is capable of performing a broad range of operations with input signals. Block diagrams of various variants of the neuron model are presented. The model contains only one active element, a semiconductor triode. It is shown that this model can perform the operations of addition, subtraction, multiplication and subtraction with weight of the frequencies of input pulse sequences in the pulsed and analog regimes of operation. Author

N66-24309# Joint Publications Research Service, Washington, D. C.

EVALUATING THE ACCURACY OF THE OUTPUT SIGNAL DURING MODELING OF DYNAMIC PROCESSES BY MEANS OF A UNIVERSAL DIGITAL COMPUTER

S. Ya. Vilenkin and E. A. Trakhtengerts *In its* Studies in Automation and Telemech. 18 Mar. 1966 p 27–39 refs (See N66-24306 13-07) CFSTI: $2.00

Methods of determining the output signal error according to known characteristics of the object and input signal are examined. The maximum and mean-square errors are estimated and the computation accuracy of the derivatives of correlation functions based on experimental data is given. The number of measurements of the input signal is determined, as is the time of its memorization assuring a specified accuracy of calculations. Author

N66-24344# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MILITARY SCIENCE: RADAR COUNTERMEASURES

Hsieh-Lin Shao 2 Aug. 1965 9 p Transl. into ENGLISH from Ko Hsueh Hua Pao (Peking), no. 11, 1962 p 422–423 (FTD-TT-64-1111/1+2+3+4; AD-619424) CFSTI: HC $1.00/MF $0.50

The article presents methods of detection, confusion and deception used in radar countermeasures. TAB

N66-24361# Delaware Univ., Newark. Dept. of Electrical Engineering.

QUANTUM FIELD THEORETICAL MODELS OF COMMUNICATION SYSTEMS

Lawrence F. Jelsma Jun. 1965 212 p refs (Grant AF-AFOSR-2-65)

(Q52; AFOSR-66-0294; AD-628711) CFSTI: HC $20.00/MF $1.25

Basic concepts in quantum field theory are used to represent communication systems. Maxwell's equations are reduced to the equations of motion of the forced simple harmonic oscillator and quantized in the Heisenberg picture. The state of a communication system is represented by a statistical density operator satisfying the postulate that the system can be in either a vacuum state or a maximum entropy state. Probability functions are derived representing the statistics of a communication system. Author (TAB)

N66-24383*# Wheeler Labs., Inc., Great Neck, N. Y.

STUDY OF SMALL OMNIDIRECTIONAL 250-Mc ANTENNA FOR PENETROMETER Final Report

Robert E. Puttre et al 29 Jul. 1965 107 p refs *Its* Rept.-1291

(Contract NAS1-4470)

(NASA-CR-66091) CFSTI: HC $4.00/MF $0.75 CSCL 09F

A small rugged omnidirectional antenna is a component of a device called a penetrometer. This device can be employed to investigate certain of the physical characteristics, including hardness, penetrability and load-support capability, of unknown surfaces such as that of our moon. The proposed antenna comprises a pair of orthogonal loops fed in quadrature for spherical-pattern radiation coverage. The loops are resonated by the series capacitors and are mounted outside of a shielded spherical core containing a telemetry transmitter, accelerometer, battery, and a directional coupler for power division with quadrature phase. Calculations indicate that the encapsulated antenna will remain intact during and after impact at 150 feet per second on a hard surface, but dynamic tests are needed for confirmation. For an antenna exactly tuned and operating at 250 Mc, with a loop radius of 1-21/32 inches, the power radiated into free space is −6 db from the power radiated from a lossless isotropic radiator. If the antenna is immersed in a dielectric medium of k−3, or impacted on a hard surface of k−7, the least power radiated toward a receiver directly overhead is computed to be −11 db and −10 db, respectively, from an isotrope. Increasing the operating frequency or the size of the antenna increases the efficiency and reduces the sensitivity to environment. Author

N66-24394*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

PHASE STABILITY ASPECTS OF THE GSFC BORESIGHT RF SOURCES

Bruno W. Reich 7 Jan. 1966 15 p ref
(NASA-TM-X-55448; X-523-66-13) CFSTI: HC $1.00/MF $0.50 CSCL 09F

Phase jitter values of a 30 mc transistorized oscillator of a space telemetry system were analyzed and studied by a camera attached to the scope. Oscillator frequency was modulated by thermal noise agitations, and the phase perturbations were measured by a phase lock loop as a function of bandwidth. Measurement data with different values of bandwidths deviated from the predicted performance in the region of 1.0 degrees peak to peak. It was believed that the inherent 60 cps hum in the tracking filter was partly responsible for this deviation.
G.G.

N66-24397*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FUNCTION DESCRIPTION OF THE APOLLO UNIFIED S-BAND DATA TRANSMISSION LINKS
John J. Schwartz 1 Feb. 1966 48 p refs
(NASA-TM-X-55453; X-506-66-36) CFSTI: HC $2.00/MF $0.50 CSCL 09F

This document contains a functional description of the data transmission links required at several Apollo S-band telecommunications and tracking stations. Two data transmission systems will be discussed in detail. The first is a microwave system which will be installed at the Madrid, Canberra and Goldstone stations. The other is an rf coaxial cable system which will be installed at the Bermuda, Hawaii and Corpus Christi stations.
Author

N66-24437# Radio Corp. of America, New York. Communications Systems Div.
CIVIL DEFENSE COMMUNICATIONS RESEARCH, TASK 1, OCD WORK UNIT NO. 2211B Final Report
K. Curtin and L. Siegel Oct. 1965 45 p refs Prepared for Stanford Res. Inst.
(CR-65-419-21, Vol. I)

The survivability problem of communications systems—from the viewpoint of analysis—is defined as the problem of relating varying levels of destruction to surviving traffic handling capability. Using linear graph concepts, three network survivability design parameters are specified and then related to varying levels of destruction. A procedure is then provided for translating surviving "connectivity" into a traffic-handling measure—the Priority Completion Index.
Author

N66-24445# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
SIGNAL PROCESSING OF PULSED SONAR IN A REVERBERANT MEDIUM Bibliography
W. Abramowitz and A. Crews Feb. 1966 57 p refs
(RM-311)

An annotated bibliography is presented which deals with sonar signal processing in a reverberant medium and includes papers on related material. The publications are grouped by subject matter and include among others adaptive techniques, ambiguity functions, correlation, linear and matched filters, stochastic processes, nonparametric methods, power spectral analysis, and statistical methods. Promising approaches to sonar reverberation are given along with papers of a tutorial, survey, or philosophical nature.
E.A.O.

N66-24447# Radio Corp. of America, New York. Communications Systems Div.
CIVIL DEFENSE COMMUNICATIONS RESEARCH, TASK 7, OCD WORK UNIT NUMBER 2211B Final Report
L. Siegel and K. Curtin Oct. 1965 80 p refs Prepared by Stanford Res. Inst.
(CR-65-419-21, Vol. I)

The concept is developed for analyzing and evaluating the evolving Civil Defense Communications System through periodic system evaluation exercises. A feasible method is presented for measuring operational capabilities using obtainable information about system characteristics, operational environments, and user needs. Appropriate criteria of system effectiveness are specified to allow selection of optimum system configurations and to provide the basis for evaluation of future systems and techniques for possible inclusion in the Civil Defense Communication System.
Author

N66-24453# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.
EVALUATION OF VHF AND UHF ANTENNA ASSEMBLIES FA-5526, FA-5527, FA-5528 Final Report
Floyd F. Jones Dec. 1965 91 p ref
(RD-65-134)

An evaluation of developmental models of VHF Antenna Assemblies and a UHF Antenna Assembly was conducted to determine their performance characteristics, capabilities, and limitations for utilization in future developmental efforts. The evaluation included the accomplishment of antenna range and flight radiation patterns for each type of antenna, measurements of voltage standing wave ratios, intercoupling measurements between antennas when installed in a hexagonal configuration, and signal intensities received during light aircraft operations, while landing and taking off at airports ranging from eight to fifty-one miles from the antenna test site.
Author

N66-24467# Joint Publications Research Service, Washington, D. C.
EQUIPMENT FOR RADIO PRINTER COMMUNICATIONS
V. P. Yagodin 6 Apr. 1966 128 p refs Transl. into ENGLISH of the book "Tekhnika Bukvopechatayushchey Radiosvyazi" Moscow, Voyenizdat, 1961 p 3-150
(JPRS-34939; TT-66-31377) CFSTI: $4.00

General construction principles, some applications, and the servicing of telegraph communication printers are discussed. This system achieves transmission and reception of a radiogram by automatic printout of the transmitted signal onto the tape of the receiving apparatus. Control of radio reception interference is obtained by removal of the receiver from possible sources of noise, usage of directional antennas, and selection of a minimum interference method for transmission. A wideband-limiter-narrowband system weakens the pulse noise and makes it thus possible to control keyed non-damping noise from other transmitters in the area. Simultaneous transmission of two different telegraphic messages is performed through one transmitter by alternate radiation at four different frequencies. Multichannel communication takes place with subcarriers using tonal telegraphy with frequency division of the channels for effective linking of the radio elements. The proper passage of transmission can be checked by measuring line current at the input of the exciter, and also with a flashing neon light connected to the circuit.
G.G.

N66-24485*# Auburn Research Foundation, Inc., Ala.
A VHF DIRECTION FINDING SYSTEM Technical Report No. 1
H. M. Summer 19 Jan. 1966 84 p
(Contract NAS8-11251)
(NASA-CR-74008) CFSTI: HC $3.00/MF $0.75 CSCL 17

An electronic direction finding system for VHF frequencies was developed that utilized a four element antenna array arranged in square formation to extract direction information in the form of a direction cosine analog. A matrix form system of phase lines and associated equipment followed the antenna array and obtained voltages with phase angles proportional to direction cosine analogs and a reference signal. The system performed satisfactorily when used with a ground plane to overcome the troublesome multipath reception problems, and when simple logic circuitry was employed to extract the desired information from the direction finding system. A theoretical evaluation of the system established improved system performance if the number of pre-amplifiers could be reduced from eight to four. G.G.

N66-24487*# Ryan Electronics, San Diego, Calif.
RYAN MODEL 520 RADAR ALTIMIMETER Final Engineering Report
N. L. Olthoff and H. T. Hoffman 1 Sep. 1963 108 p *Its* Rept.-52067-1
(Contract NAS8-2459)
(NASA-CR-74546) CFSTI: HC $4.00/MF $0.75 CSCL 09F

An accurate radar altimeter for use in the Saturn vehicle was designed, fabricated, tested, and delivered. The instrument determines altitude in areas where tracking stations are not available. Bench test results and limited results of flight tests show that the Model 520 altimeter meets the operational requirements, specifically the accuracy and altitude requirements of space missions. Further evaluations are necessary for determining if the instrument meets the vibration requirements. Other requirements of the altimeter, regarding pulse width, antenna, reflectivity and signal attenuation, signal-to-noise ratio, digital output frequency, signal waveform, and backscattering are also discussed. L.S.

N66-24492*# Michigan Univ., Ann Arbor. Radiation Lab.
RADIATION DUE TO AN OSCILLATING DIPOLE OVER A LOSSLESS SEMI-INFINITE MOVING DIELECTRIC MEDIUM
Vittal P. Pyati Feb. 1966 124 p refs *Its* Rept.-7322-2-T
(Grants NGR-23-005-107; NsG-572)
(NASA-CR-74550) CFSTI: HC $4.00/MF $1.00 CSCL 20N

Boundary value problems for radiation fields due to an oscillating (Hertzian) dipole over a lossless semi-infinite moving dielectric medium are analyzed. Lossless means zero conductivity and the dipole source is assumed to be located in free space or vacuum which is stationary with respect to an observer in whose frame of reference all the fields are determined. In addition, the problem of reflection and refraction of a plane electromagnetic wave traveling in free space and striking a moving dielectric boundary was solved. The solution was found by first determining plane wave solutions in an unbounded moving medium. The resulting wave number, the refractive index, of the moving medium was found to be a function of the velocity, the direction of propagation, and n, the refractive index in a rest frame. The mathematical solutions of the above wave problems are given in detail, and curves are used for illustration where necessary throughout. One conclusion from the calculations is that when a plane electromagnetic wave, traveling in free space, strikes a uniformly moving semi-infinite dielectric medium, the incident, the reflected, and the transmitted waves are coplanar and the angle of reflection is equal to the angle of incidences. L.S.

N66-24513*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SYSTEMS COMPARISON OF DIRECT AND RELAY LINK DATA RETURN MODES FOR ADVANCED PLANETARY MISSIONS
T. A. Barber, J. M. Billy, and R. D. Bourke 15 Feb. 1966 81 p refs
(Contract NAS7-100)
(NASA-CR-74653; JPL-TM-33-228) CFSTI: HC $3.00/MF $0.75 CSCL 17B

This report analyzes advanced planetary missions using a Saturn IB and simultaneous orbiting and landing spacecraft. An analysis of the relative data return capability of two alternate modes is given. One mode (named the relay link) uses transmission of the lander produced data to a planetary relay communications satellite, then transmission to the Earth; the other (named the direct link) uses transmission directly from the lander to the Earth. Numerical results are given for sample advanced planetary missions to Mars. Author

N66-24600*# Electro-Optical Systems, Inc., Pasadena, Calif.
SOLAR REFLECTING BEACON, PHASE I
O. E. Stewart and B. E. Kalensher 3 Dec. 1965 158 p refs
(Contract NAS9-4790)
(NASA-CR-65255; EOS-6976, Phase I) CFSTI: HC $5.00/MF $1.00 CSCL 17I

Static and dynamic design concepts including tracking beacons, photometric analysis of beacon detection, reliability as affected by the lunar environment, materials analysis, location requirements, and preliminary weight and packaging determinations are reported in a program to develop solar reflecting beacons. On the basis of this study, a tracking flat specular earth reflector with an area of 33 sq ft and a field of view of 6.75×10^{-6} steradians is recommended. For a cislunar beacon to be viewed at a maximum slant range of 400 nautical miles, an oscillating arch specular beacon having a total surface area of 19 sq ft and an effective reflective area of 4.44×10^{-2} sq ft is recommended. Detailed technical analyses of these recommended concepts plus other beacon types that have been studied are included in a technical discussion with actual data, analyses, tables, curves, diagrams, and sketches. C.T.C.

N66-24602*# Hughes Aircraft Co., Culver City, Calif. Research and Development Div.
HIGH-GAIN, SELF-STEERING ANTENNA SYSTEM, ENGINEERING MODEL Design Review Report
R. A. Birgenheier and C. Lew Mar. 1966 95 p
(Contract NAS5-10101)
(NASA-CR-74260; P-66-68) CFSTI: HC $3.00/MF $0.75 CSCL 09F

This report covers the design of an engineering model of the self-phasing type antenna array, and includes the appropriate trade-offs that were made to obtain the desired objectives. Design considerations include trade-offs necessary to minimize the number of components, number of array elements, modules, radiated power per module, and primary power requirements. Components in the model not readily capable of being space-qualified are specifically identified. C.T.C.

N66-24877# Signals Research and Development Establishment, Christchurch (England).
A SHORT RANGE RADIO WITH SELECTIVE CALLING FOR MILITARY USE
P. L. W. Gibbons Mar. 1965 67 p refs
(SRDE-1139)

Seven experimental models of a short range two-way radio have been constructed to gain experience in selecting calling (RADAS) principles. The system chosen employed 200 nanosecond pulses of 165 Mc/s, frequency modulated by voice, with an output power of 10 milliwatts mean and 2 watts peak. One hundred five different address codes were provided. Theoretical performance was obtained, the range being 500 yards, and mutual interference between a small number of users not disturbing. The equipment constructed used transistors throughout and operated from internal batteries. No precise tuning or other adjustments were required and it was cheap and mechanically simple. Author

N66-24681# General Electric Co., Philadelphia, Pa. Missile and Space Div.

ANTENNA BREAKDOWN IN PLANETARY ATMOSPHERES

W. K. Kinkead Sep. 1965 72 p refs

(Doc.-65SD317)

A number of tests were carried out aimed at investigating and improving the voltage breakdown of antennas in air and gases expected to be found in other planetary atmospheres. Techniques used for improving breakdown levels were geometry optimization, use of superimposed DC fields, and use of lightweight dielectric materials. Author

N66-24688*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SPACE TRACKING AND DATA ACQUISITION NETWORK FACILITIES REPORT (STADAN)

Dec. 1965 192 p

(NASA-TM-X-55438; X-530-66-33; NASA-TM-X-55026; X-539-64-159) CFSTI: HC $5.00/MF $1.25 CSCL 17B

The facilities, systems, equipment, and functions of the space tracking and data acquisition network are described. The functions and equipment of the Minitrack system are discussed. The data acquisition facilities and instrumentation are given. The Goddard range and range-rate system are reported. The mobile systems, programmable command system, and time standard system are also mentioned. N.E.N.

N66-24709# Syracuse Univ. Research Inst., N. Y. Dept. of Electrical Engineering.

DUALITY AND INFORMATION COMPONENTS IN FOURIER TRANSFORMS Technical Report No. 9

Stanford Goldman Jan. 1966 83 p refs

(Contract Nonr-669(10))

(EE-494-661-T-9; AD-628929) CFSTI: HC $3.00/MF $0.75

This paper considers signals or waveshapes in terms of their information components and considers the dual representation of signals in Fourier transform domains. Certain duality aspects between Fourier series and sampling theorem expansions are discussed. The duality between linear transmission and analytic signal modulation is pointed out, of which, the duality between distortions echoes in the time domain and sidebands in the frequency domain is a particular example. It is shown that sampling theorem expansions can be expressed in terms of distortion echoes of the elementary function delta (t-t') and also in terms of sidebands of the elementary function $e^{j2\pi f_o t}$. Relations between waveshape properties in the time and frequency domains are considered from several points-of-view and new insight is thereby gained. The relation between the autocorrelation function and intersymbol influence is analyzed, and the importance of phase distortion echoes, previously ignored in this connection, is pointed out. Finally, there is a discussion of the relations between signal structure and resolution. In the appendices, certain characteristics of analytic signals and Hilbert transforms which are of interest in modulation theory are derived. Some of these the writer has not been able to find in previous literature. Author (TAB)

N66-24716# Navy Underwater Sound Lab., New London, Conn.

THE QUASI-STATIC FIELDS OF DIPOLE ANTENNAS, PART II

Peter R. Bannister and William C. Hart 8 Feb. 1966 27 p refs

(USL-719; AD-628217) CFSTI: HC $2.60/MF $0.50

The electric and magnetic field components produced by vertical and horizontal electric dipoles are presented for the quasi-static range of the absolute value $\gamma_{o\rho}<<1<$ absolute value $\gamma_{1\rho}$ with absolute value $\gamma_{oz}<<1$, h=0, and z>or=0. The special case of burying the transmitting dipole (h< or =0) is also considered. This range has been considered by many writers, but with the restriction that $\rho>>z$. In this report, the authors evaluate the previously underived (to the author's knowledge) components that are valid for any height z (neglecting ionospheric effects). Author (TAB)

N66-24718# Naval Research Lab., Washington, D. C.

VLF RELATIVE PHASE PREDICTIONS FOR SELECTED TRANSMISSION PATHS

W. E. Garner and R. L. Schauer 14 Feb. 1966 118 p refs

(NRL-MR-1670; AD-628986) CFSTI: HC $4.00/MF $0.75

Predictions of the relative phase of seven very low frequency (vlf) transmissions as received at selected receiver locations, during the summer and winter solstice, and the spring and fall equinox, are presented. The vlf transmitting stations and the operating frequencies considered are NWC (15.5 kc/s), NPM (26.1 kc/s), NPG (18.6 kc/s), NAA (17.8 kc/s), NBA (24.0 kc/s), NSS (21.4 kc/s), and GBR (16.0 kc/s). The receiving locations used are Guam, Honolulu, San Francisco, San Juan, Norfolk, Keflavik, Port Lyautey, and Asmara. However, predictions are not presented for all the transmitter-receiver location combinations given above. Author (TAB)

N66-24723# RAND Corp., Santa Monica, Calif.

EVALUATION OF THE DETERMINANTAL POLYNOMIAL OF A MATRIX OF POLYNOMIAL ELEMENTS AND AN APPLICATION TO AMTI RADAR

M. I. Liechenstein Jan. 1966 129 p refs

(Contract AF 49(638)-1700; Proj. RAND)

(RM-4837-PR; AD-628554) CFSTI: HC $4.00/MF $1.00

The requirement to expand the determinant of a matrix whose elements are polynomials of a common variable is encountered frequently in system analyses and optimizations. Inasmuch as this generalized eigenvalue problem is pertinent in studies of system behavior and synthesis for a broad class of systems, it is desirable to secure a computational technique, amenable to both manual and machine execution, which enables efficient calculation of the coefficients of a determinantal polynomial. To this end, an algorithm is derived, computer programs detailed, and tables provided in this Memorandum which accomplish the polynomial evaluation predominantly by reference to established tables. The particular application which motivated the computational technique detailed in this memorandum arose from renewed inquiry into problems of airborne radar signal synthesis. The need to evaluate the determinantal polynomial and roots of matrices is found in the design equations for processors of signals in airborne moving

target indicator (AMTI) pulse doppler radars. The relevance of the algorithm to the construction of AMTI systems with characteristics enhancing detection of objects over land is clarified in this memorandum through the discussion of a generalized delay-line canceler signal processing scheme. Author (TAB)

N66-24727# Bureau of Naval Weapons Representative, Pomona, Calif.
MEASUREMENT OF FREQUENCY DERIVATION
K. H. Klarer 15 Mar. 1965 25 p
(EC-12; AD-628415) CFSTI: HC $1.00/MF $0.50

The information contained in this circular is intended solely for the utilization of the Navy Calibration Program. Frequency deviation, swept symmetrically from a center frequency, is often used in the alignment of frequency modulation receivers. Other uses are the alignment or test of video amplifiers for radar service and wideband amplifiers where the rapid and accurate setting of the bandpass and contour are desired. The purpose of this circular is to discuss several methods which have been used or developed to measure the accuracy of FM generators commonly used to meet the above needs. TAB

N66-24752# Joint Publications Research Service, Washington, D. C.
FREQUENCY AND FREQUENCY-TIME SYSTEM OF DIGITAL TELEMETERING
B. S. Didyk 7 Apr. 1966 37 p refs Transl. into ENGLISH from Chastotnyye i Chastotno-Vremennyye Sistemy Diskretnogo Teleizmereniya (Kiev), p 2-17, 84-97
(JPRS-34952; TT-66-31390) CFSTI: $2.00

This book describes systems for discrete telemetry using frequency and frequency-time codes; different variants of analog-to-digital converters; and presents an analysis of the errors. Descriptions are given of the code formation methods, the fundamentals of the design and analysis of noncontacting coders and decoders, and also the hardware. The book is intended for engineers working in the field of telemechanics and may be useful to students of the senior courses in the corresponding specialities. Author

N66-24772# Army Electronics Labs., Fort Monmouth, N. J.
LOW-LEVEL, CROSSED-FIELD NOISE STUDY
Joseph H. Hartley Feb. 1966 26 p refs
(ECOM-2659; AD-629125) CFSTI: HC $2.60/MF $0.50

Experimental investigations of low-frequency electron tube noise are discussed. The work was done using experimental diodes with a coaxial configuration. The cathode is centrally located and surrounded by a concentric anode, split longitudinally into two equal sections. A magnetic field was applied colinear with the cathode. The investigation was confined to values of anode potential and magnetic field strength so that the experimental tubes were well beyond the Hull cutoff value at all times. The experiments were oriented primarily toward investigation of millivolt level oscillations in the frequency range of 0.5 to 10 megacycles. These oscillations are believed to be related in some manner to noise encountered in crossed-field microwave tubes. The mechanism of the oscillations is, as yet, unknown. Author (TAB)

N66-24794# California Univ., Los Angeles.
INFORMATION AMOUNT AS A MEASURE CORRECTING ONE'S PRIOR PROBABILITY
Koichi Miyasawa Apr. 1965 55 p refs *Its* Working Paper No. 73
(Contract Nonr-233(75))
(AD-617326) CFSTI: HC $3.00/MF $0.75

Several kinds of definition of information amount or information value have been proposed by several authors. The author attempts to define information amount as a measure of correcting one's prior probability distribution on the state space. By combining two informations concerning the same decision partition, it is shown that the combined information has a greater information amount than the separate ones. When two different types of information—in the sense they are concerned with different decision sub-partitions of the ultimate decision partition—it is shown how they should be aggregated to obtain more informative information concerning the ultimate decision partition. Author (TAB)

N66-24895# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands)
SURVEY OF LITERATURE ON ELECTROTECHNOLOGY [LITERATUUROVERZICHT ELECTROTECHNIEK]
7 Mar. 1966 40 p refs In ENGLISH, GERMAN, and DUTCH *Its* Vol. 15, No. E-482
CFSTI: HC $2.00/MF $0.50

Abstracts on various aspects of research and development studies in the field of electronics are given. Among the topics covered are: telecommunications, international radio administration, waveguides and traveling wave devices; radar equipment, systems, and uses; electromagnetic radiation measurement and propagation; information handling; computer codes, algorithms, algebraic manipulation, logic and circuit design; control and data evaluation techniques; miniature integrated circuits; interference and noise; and electronic equipment and materials. N.E.N.

N66-24939*# Space Technology Labs., Inc., Redondo Beach, Calif.
STUDY OF SPACECRAFT TRANSPONDER POWER AMPLIFIER Final Report
R. R. Cagnon, K. E. Lytal, and S. D. Mc Caskey Aug. 1964 200 p refs
(Contract NAS5-3423)
(NASA-CR-74775; STL-4104-6001-RU-000) CFSTI: HC $5.00/MF $1.25 CSCL 09F

This report covers a study program conducted to investigate the feasibility of a wideband, direct RF to RF conversion communication satellite transponder, utilizing a TWT in a re-entrant mode. After amplification by the TWT, the signal(s) are frequency translated and reamplified by the same TWT. Pre- and post-amplification is provided to establish system sensitivity and dc to RF conversion efficiency. The optimum transponder type and configuration was determined, fabricated, and evaluated. Analysis of the measured performance is presented with emphasis on the baseband distortion characteristics for both single and multiple signals. Unusual characteristics of the TWT as operated in the re-entrant mode are also analyzed and presented. The gain, output power, and noise figure obtained with the re-entrant transponder were established to be consistent with the basic requirements of a communication satellite. The major advantage offered is reduced transponder complexity and the extremely wide bandwidths which can be realized. Author

N66-24858*# Hughes Aircraft Co., Culver City, Calif. Antenna Dept.
SPACECRAFT ANTENNA SYSTEMS Final Engineering Report, Oct. 1963–Jan. 1966
W. H. Kummer and R. A. Birgenheier Mar. 1966 120 p refs
(Contract NAS5-3545)
(NASA-CR-74728; P66-66) CFSTI: HC $4.00/MF $0.75 CSCL 09F

Results are given of a spacecraft antenna systems study aimed at recognizing advanced antenna techniques that will provide communications systems that are highly reliable and low in power consumption. A survey of the state-of-the-art in antenna techniques, especially beam-steering concepts, identified several promising self-steering methods. Two specific techniques were designed and built as breadboards; a multiple-beam transdirective concept, and a self-phasing retrodirective concept. Both have 10-MHz bandwidths with center frequencies of 6.301 GHz for the up-link and 4.081 GHz for the down-link. The multiple-beam breadboard uses two separate 4-by-4 arrays and two beam-forming matrices, one to form multiple beams to receive an information signal from one arbitrary direction and the other to form beams for retransmission in response to a pilot signal from another arbitrary point. The self-phasing breadboard uses the same 4-GHz array for transmitting as the multiple-beam system and automatically forms a high-gain beam in response to a pilot signal to relay information previously received. C.T.C.

N66-24961*# Planning Research Corp., Washington, D. C.
GEOS COMMAND ASSIGNMENT
Charles E. Bloomquist 31 Mar. 1966 70 p refs *Its* Tech. Advisement Memo. No.-106-13
(Contract NASw-1180)
(NASA-CR-74738; PRC-D-1190) CFSTI: HC $3.00/MF $0.75 CSCL 09F

A methodology for assigning command functions to the relay matrix positions of the GEOS command subsystem was investigated to enhance overall satellite operational reliability. The command subsystem, the command function, and the assignment criteria were analyzed to provide a basis for the generalized assignment methodology. It was found that the assignment of two command intersections per command function was nearly optimal. Groups of related commands might be considered for improved assignment. An analysis was made of the failure mode and effects and also the relative state probabilities. It was noted that the differences between the assignments derived and those actually used on the GEOS spacecraft were quite small. E.A.O.

N66-24973*# Northeastern Univ., Boston, Mass. Communications Research Group.
[UTILIZATION OF INFORMATION THEORY IN DIGITAL DATA GUIDANCE SYSTEMS] Quarterly Progress Report No. 2, 1 Dec. 1965–28 Feb. 1966
Sze-Hou Chang 23 Mar. 1966 20 p refs
(Grant NGR-22-011-013)
(NASA-CR-74689) CFSTI: HC $1.00/MF $0.50 CSCL 09D

Studies were undertaken to fabricate decoding schemes that would not involve solving simultaneous equations in an algebraic extension field. A method is described which uses the cyclic property of the binary three-error-correcting (15,5) B-C-H code and one of its algebraic structures to correct all the three or less errors in any received code word. The mathematical equations for this process are described and the various steps in the decoding procedure are discussed. Dual product codes are defined and tables are shown which illustrate the error control capabilities of the component codes and the product codes. A scheme for implementing m-ary logic in cyclic codes is also described. It is stated that the method of implementation is primarily dependent upon the triggering of any or all m-1 threshold circuits. By a proper choice of these threshold circuits, the input level is determined, a Boolean transformation is performed on the threshold circuit outputs to convert to binary form, and finally the binary form is converted to its respective analog equivalent. A sampling theorem for a time function is also presented, and a generalization of this theorem which provides a similar sampling theorem for time functions which are not necessarily bandlimited, but which do have similar restrictions is examined. H.S.W.

N66-24975*# Northeastern Univ., Boston, Mass.
A NOTE ON NON-BINARY ORTHOGONAL CODES
Sze-Hou Chang [1965] 11 p refs
(Grant NGR-22-011-013; Contact AF 19(628)-3312)
(NASA-CR-74691) CFSTI: HC $1.00/MF $0.50 CSCL 09D

The construction of orthogonal matrices using integers as elements was considered. Three methods were explored; maximum length sequences, construction by inspection, and recursive methods. The development of these methods is discussed and the mathematical considerations involved are examined. H.S.W.

N66-24990*# Collins Radio Co., Dallas, Tex.
DESIGN ANALYSIS—UNIFIED S-BAND SYSTEM FOR APOLLO NETWORK, VOLUME 3, PART V (CONT.) Engineering Report
9 Nov. 1964 186 p refs *Its* Rept.-523-0556527-001D3M
(Contract NAS5-9035)
(NASA-CR-74713) CFSTI: HC $5.00/MF $1.25 CSCL 17B

This report presents the results of an analysis of data demodulation equipment requirements for Apollo unified S-band ground tracking stations which was performed to define optimum system parameters to be used in equipment specifications. Functional block diagrams of the subsystem and each subunit are given. Factors affecting the interface between the GSFC specification and present Apollo command module equipment specifications and changes in command module equipment, which would affect the ground system data demodulation equipment, are discussed. Results were incorporated into a specification which describes the subsystem to be implemented for the Apollo program. R.N.A.

N66-25012*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TRACKING AND DATA ACQUISITION REPORT: MARINER MARS 1964 MISSION. VOLUME I: NEAR-EARTH TRAJECTORY PHASE
N. A. Renzetti 1 Jan. 1965 80 p
(Contract NAS7-100)
(NASA-CR-74847; JPL-TM-33-239) CFSTI: HC $3.00/MF $0.75 CSCL 09F

This document summarizes the technical activities of the AFETR, certain stations of the NASA/GSFC manned space flight network and satellite tracking and data acquisition network, and the NASA/JPL deep space network in support of the near-earth trajectory phase of the Mariner Mars 1964 Mission. Included in this document are the tracking and data acquisition requirements and related support plans for all the participating agencies, a comprehensive account of the tracking operations, and a performance evaluation summary.
Author

N66-25015*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
INFORMATION TRANSFER SYSTEMS IN SPACE COMMUNICATIONS
Amadeo Dabul Washington, NASA, May 1966 88 p refs
(NASA-TN-D-3405) CFSTI: HC $3.00/MF $0.75 CSCL 17B

A comprehensive survey and study of the basic parameters of information transfer systems for space communications is presented to familiarize systems checkout engineers with the state-of-the-art and trends in this field because it now appears that on-board systems will be depended on for checkout performance and checkout data transfer. Both current and anticipated requirements for communication systems are considered. Some of the problems that exist in space communication are presented along with a general review of present communication systems, their capabilities, and their limitations. It is concluded that present space communication systems are adequate for all communication needs of lunar missions, including transmission of visual and audio channels and tracking, telemetry, and command functions. They can also satisfy the basic communication needs of unmanned planetary missions to Mars, and, in the near future, to Venus, provided the attitude-control system of the space vehicle can keep the vehicle's antenna accurately pointed at the Earth. The increased capabilities expected by the end of this decade should make adequate space communication systems possible for most predicted communication needs of the future.
Author

N66-25106# Sandia Corp., Albuquerque, N. Mex.
A PRELIMINARY REPORT ON THE INTERACTION OF AN ELECTROMAGNETIC FIELD WITH A MISSILE HAVING AN IONIZED TRAIL
Charles W. Harrison, Jr., Clayborne D. Taylor, and Richard D. Ruquist (Harvard Univ., Cambridge, Mass.) 15 Oct. 1965 30 p refs
(Contract AT(29-1)-789)
(SC-DC-65-1797) CFSTI: HC $2.00/MF $0.50

A missile with plume (ionized trail) in flight at relatively low altitudes is treated as an isolated cylindrical receiving antenna. One portion of the antenna is considered to be perfectly conducting and represents the missile; the other section of the antenna is assumed to be imperfectly conducting and represents the plume. In the present version of the theory no charge is permitted to build up between the portions of the antenna. The incident electromagnetic field is assumed to be a plane wave with the electric field polarized parallel to the axis of the missile and plume. The current distributions along both the missile and plume are obtained by solving the nonhomogeneous differential equations for the currents in the two antenna sections subject to appropriate boundary conditions.
Author (NSA)

N66-25175# RAND Corp., Santa Monica, Calif.
NUMERICAL PROGRAMS FOR SOLVING HYPERBOLIC SYSTEMS BY THE METHOD OF CHARACTERISTICS: RADIO EMISSION FROM A NUCLEAR EXPLOSION, PART I
G. H. Peebles Mar. 1966 60 p refs
(RM-4942)

Two programs are presented which calculate the solution for a hyperbolic system of partial differential equations with three constant characteristic directions. The computations are on a net of characteristics of variable mesh, the size of the mesh being determined by a criterion of accuracy. The first program ranges over four mesh sizes; the second, over nine
Author

N66-25196*# National Aeronautics and Space Administration, Washington, D.C.
GOLDSTONE DEDICATION, APRIL 29, 1966
26 Apr. 1966 22 p
(NASA-News Release-66-88) CSCL 09F

A general news release is presented of the dedication of a space tracking and telemetry antenna at Goldstone, Cal. Major specifications of the 210 foot diameter antenna are given, and its operation is outlined. A brief history and background of the antenna are given along with descriptions of other large antennas.
C.T.C.

N66-25315# Joint Publications Research Service, Washington, D. C.
SPEECH PATTERN RECOGNITION
I. T. Turbovich and O. A. Petrov 12 May 1966 21 p refs
Transl. into ENGLISH from the book "Opoznaniye Obrazov—Teoriya Peredachi Informatsii" Moscow, 1965 p 25-36
(JPRS-35475; TT-66-31911) CFSTI: $1.00

CONTENTS:

1. ONE METHOD FOR COMPLETELY DESCRIBING ONE-DIMENSIONAL PATTERNS BY A SET OF SIMPLE FUNCTIONS (APPLICABLE TO SPEECH SIGNALS) I. T. Turbovich and O. A. Petrov p 1-7 refs
2. STATISTICAL PROCESSING OF PRIMARY ATTRIBUTES OF SPEECH SIGNALS WITH THE AID OF AN ELECTRONIC COMPUTER O. A. Petrov p 8-16 refs

N66-25377*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ATLAS-CENTAUR VI FLIGHT PATH AND ITS DETERMINATION FROM TRACKING DATA
L. W. Miller et al 15 Apr. 1966 169 p refs
(Contract NAS7-100)
(NASA-CR-74951; JPL-TR-32-911) CFSTI: HC $5.00/MF $1.00 CSCL 17I

This report describes the best current estimate of the Atlas-Centaur VI (A/C-6) spacecraft flight path and the way in which the flight path was obtained. This document also includes orbit determination program printout data facsimiles.
Author

N66-25380# Army Electronics Labs., Fort Monmouth, N. J.
POLARIZATION VARIATION OF SATELLITE-EMITTED RADIO SIGNALS
Paul R. Arendt, Wolfgang H. Fischer, James Grau, Haim Soicher, and Gottfried F. Vogt Mar. 1966 41 p refs
(ECOM-2671; AD-630192) CFSTI: HC $4.60/MF $0.50

A new system for the measurement of the actual momentary values of the Faraday rotation polarization vectors of satellite emitted frequencies has been developed. Measurements of the relative polarization angles of the S-66 Satellite-emitted 40 to 41 Mc/s signals, from which the absolute rotation angle is obtained, have been made at one-second intervals. A comparison of momentary polarization angles at 40 and 41 Mc/s made during the center part of overhead satellite passages shows deviations from the expected inverse frequency squared relation. It has been found that correct raw data can only be obtained from the difference of simultaneous polarization measurements during a short interval when this difference is near pi radians. Correction for antenna geometry error and for nonlinear system errors permits electron content evaluation with 1% precision over a latitudinal range of about ten degrees.
Author (TAB)

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N66-23907# Naval Avionics Facility, Indianapolis, Ind.
CODED CIRCUIT ANALYSIS. VOLUME I: INSTRUCTION MANUAL FOR DC-AC APPLICATIONS
Larry M. Turpin 6 Sep. 1965 106 p
(NAFI-TR-544; AD-628110) CFSTI: HC $4.00/MF $0.75

This report contains information about the Computer Oriented Design of Electronics Devices (CODED) Circuit Analysis programs; procedures for their use, applications, capabilities, limitations, and examples. Two of the CODED programs discussed in this report are for AC analysis and two for DC analysis. Author (TAB)

N66-23913# California Univ., Los Angeles. Dept. of Engineering.
THE AUTOMATIC ASSIGNMENT AND SEQUENCING OF COMPUTATIONS ON PARALLEL PROCESSOR SYSTEMS
David F. Martin Jan. 1966 425 p refs
(Contracts Nonr-233(52); AT(11-1)-GEN-10)
(Rept.-66-4; AD-628220) CFSTI: HC $7.25/MF $2.00

The problem of optimal a priori assignment and sequencing of computations on parallel processor systems is investigated. The problem is formulated as a mathematical program in which it is desired to minimize a defined expected cost of computation subject to (1) maintaining partial orderings between computations; (2) a feasible computation-processor correspondence; (3) system inventory constraints. The method of solution is one of successive approximation, consisting of a systematic perturbation of an initial feasible assignment and sequence, accepting or rejecting trial solutions to achieve monotonic cost reduction. Since only a limited portion of the solution space is explored, the solution is generally suboptimal. The partially-ordered set of computations is represented by a cyclic directed graph, the characterization of which requires a priori estimates of arc traversal (branching) probabilities, the expected number of times each cycle will be traversed, and the mean execution times of each computation. Each processor is characterized by an operation list and a mean execution time vector. Analytical contributions in this study include computationally efficient algorithms for vertex computational probabilities and approximate mean path length on acyclic directed graphs, and the formal transformation of a restricted class of cyclic directed graphs into temporally-equivalent acyclic graphs. TAB

N66-23918# Frankford Arsenal, Philadelphia, Pa. Fire Control Engineering Directorate.
IDEEA NETWORK IMPLEMENTATION, FISCAL YEAR 1965
J. E. Torrey Jan. 1966 28 p ref
(M66-16-1; AD-629225) CFSTI: $2.00/MF $0.50

The IDEEA Network is a five-station experimental system for the storage, retrieval, and dissemination of chemical structures and data. The Network is being implemented with available hardware and will be used to collect data on the rates and modes of use. The Network concept and the hardware to be used in the Network are described. The effort that was applied to the Network implementation during Fiscal Year 1965 is also described. Author (TAB)

N66-23950# Norwegian Defence Research Establishment, Kjeller.
DIGITAL SIMULATION OF A DIGITAL SPECTRUM ANALYZER
Jarl Johnsen Oct. 1965 43 p refs
(U-180; AD-629387) CFSTI: HC $2.00/MF $0.50

A digital spectrum analyzer, simulating a bank of narrowband filters followed by square law detectors, is simulated on a digital computer. The analyzer is described and discussion concerning frequency resolution, signal distortion, output signal to noise ratio and the effect of various degrees of quantization is based on data from the simulated analyzer. Author (TAB)

N66-23971# Systems Development Corp., Santa Monica, Calif.
UPDATING OF THESAUR PROGRAM
Sally Yeates Sedelow and Terry Ruggles 17 Dec. 1965 53 p
(Contract Nonr-4427(00))
(TM-1908/009/00; AD-629368) CFSTI: HC $5.60/MF $0.50

This document updates the description of THESAUR, the third section of the stylistic analysis program contained in TM-1908/100/00, 'Stylistic Analysis: report on the first year of research,' 1 March 1965. The revised THESAUR incorporates changes designed for better retrieval of concept continuities as well as for more adequate display of both continuities and discontinuities. One of the major changes has been the introduction of SUFFIX, the root-finding section of the program, into THESAUR. This new use of SUFFIX enlarges considerably the number of words retrieved; searches in THESAUR had previously been word specific. One change in the output is retention of linking words (primary words which also occur as associated words), even though they do not occur in the section of text under examination (this fact is indicated through a comment). Changes also include a clear indication of the initial appearance of a given word with a particular word grouping, and a number of other features which make the output more readable and informative.
Author (TAB)

N66-23975# Johnson Service Co., Milwaukee, Wis. Research Div.
LOW PRESSURE SIGNAL SENSOR AMPLIFIER AND ANALOG COMPUTER USING THE IMPACT MODULATOR AS THE BASIC ACTIVE PURE FLUID DEVICE. PART I: ANALOG COMPUTER Final Report, Oct. 1, 1964-Sep. 30, 1965
Thomas J. Lechner 1 Dec. 1965 80 p refs
(Contract DA-49-186-AMC-126(D))
(AD-629055) CFSTI: HC $3.00/MF $0.75

Fluidic operational amplifiers and integrators have been designed and tested. The amplifier gains and integrated rate gains are shown to depend only upon the passive circuitry. First and second order linear differential equations with constant coefficients have been solved with these computing devices. Deviations between the computed and calculated first order solutions were less than 2%. Second order equations with damping greater than 0.8 also showed errors of 2% or less. Damping less than 0.8 but greater than 0.4 had less than 5% error, and lighter damped systems, including zero damping, showed errors of 8% or less. Suggestions have been made for system accuracy improvement, and also for extensions in the state of the art for fluidic computing systems. Author (TAB)

N66-24057# RAND Corp., Santa Monica, Calif.
THE CATALOG INPUT/OUTPUT SYSTEM

Martin Kay, Frederick Valadez, and Theodore Ziehe Mar. 1966 71 p refs
(Contract AF 49(638)-1700; Proj. RAND)
(RM-4540-PR; AD-629606) CFSTI: HC $3.00/MF $0.75

A complete definition of the format used for catalogs on magnetic tape and a description of the routines of the catalog input–output system are given. Catalog maps, catalog data, and tape labels are written as logical records in a specially designed blocking format. Beginnings and ends of blocks, physical tapes, and catalogs are explicitly marked. The catalog input/output system offers a variety of input/output unit-control operations in addition to the commands for reading and writing data in catalog format. The reading and writing commands are implemented on three levels: level III handles individual data; level II reads and writes logical records; and level I processes blocks of information. Author (TAB)

N66-24059# Entelek, Inc., Newburyport, Mass.
COMPUTER-ASSISTED INSTRUCTION: A SURVEY OF THE LITERATURE Semiannual Report, Jul. 1–Dec. 31, 1965
Albert E. Hickey and John M. Newton Jan. 1966 37 p refs
(Contract Nonr-4757(00))
(Rept.-66-101; AD-628953) CFSTI: HC $2.00/MF $0.50

A selective review was made of 100 documents related to computer-assisted instruction (CAI). Headings: applications, systems, languages, instructional theory, programing, evaluation and administration. Appendices list programs by subject matter, institutions with CAI, and central computers in CAI systems. Author (TAB)

N66-24113*# University of Southern Calif., Los Angeles. Dept. of Electrical Engineering.
COMPUTING METHODS IN OPTIMIZATION PROBLEMS: GRADIENT METHODS FOR THE OPTIMIZATION OF DYNAMIC SYSTEM PARAMETERS BY HYBRID COMPUTATION
George A. Bekey and Robert B. Mc Ghee [1963] 27 p refs
(Grants NGR-05-018-022; AF-AFOSR-75-63)
(NASA-CR-71806) CFSTI: HC $2.00/MF $0.50 CSCL 09B

Computer implementation of both continuous and discrete gradient methods is discussed, in relation to adjusting the parameters of a dynamic system to obtain a close match to a specified response function. The formulation of a continuous steepest descent algorithm is reviewed, the difficulties are assessed, and computer results relating to the nature of the gradient and the dependence of the path in parameter space on adjustment gain are given. Several discrete gradient optimization techniques are summarized, and an algorithm for automatic adjustment of step size for gradient descent is presented. The stability and convergence properties of first and second order iteration schemes are compared, and some results are given in the form of a convergence theorem. Examples are included to illustrate the application of discrete parameter optimization methods to a nonlinear dynamic system. A hybrid computational strategy for parameter optimization is formulated, which includes the best features of both the analog and digital computer solutions. M.G.J.

N66-24133# Joint Publications Research Service, Washington, D. C.
BASIC CHARACTERISTICS OF A MODEL LEARNING AUTOMATON AND SOME RESULTS OF TEACHING IT TO RECOGNIZE VISUAL PATTERNS
Ye. K. Aleksandrov, V. L. Sul'povar, and V. I. Timokhin *In its* Bionics 20 Apr. 1966 p 52–59 ref (See N66-24126 13-04) CFSTI: $9.10

To check the operating principles of a learning automaton, a small model was constructed of semiconductor triodes and magnetic cores with a recilinear hysteresis loop. With the use of three simple ferrite transistor cells and an accumulative memory element of three transfluxors, an automaton was achieved which had 64 binary inputs, 16 threshold elements with 16 memories, and one output. Continuous, impulse series, and single pulse algorithms were used for training the automaton. Basically the training procedure consisted of selecting six of a set of possible elements of each pattern of a training series; selection criterion was that the elements were the most characteristic representation of the given pattern. The feedback line was closed after the elements were inserted, and the device was checked for correctness of response, with repetition of cases in which incorrect answers were given. After the completion of the training, the capacity of the automaton for correct recognition of new elements of the same pattern was sometimes greater than 80%. M.W.R.

N66-24286# Joint Publications Research Service, Washington, D. C.
PROBLEMS IN CYBERNETICS
A. A. Lyapunov, ed. 7 Mar. 1966 441 p refs Transl. into ENGLISH of the book "Problemy Kibernetiki" Moscow, No. 15, 1965 p 1–292
(JPRS-34423; TT-66-30863) CFSTI: $7.08

CONTENTS:

1. ON FUNCTIONAL COMPLETENESS IN CALCULABLE LOGIC G. P. Gavrilov p 1–103 refs (See N66-24287 13-19)

2. SOLUTION OF THE PROBLEM OF COMPLETENESS FOR SYSTEMS OF FUNCTIONS OF THE ALGEBRA OF LOGIC WITH UNRELIABLE REALIZATION S. G. Gindikin and A. A. Muchnik p 104–132 refs (See N66-24288 13-10)

3. ON THE PROBLEM OF REALIZATION OF SYMMETRICAL FUNCTIONS OF THE ALGEBRA OF LOGIC BY CONTACT CIRCUITS O. B. Lupanov p 132–155 refs (See N66-24289 13-10)

4. TRANSFORMATIONS OF FINITE AUTOMATA V. L. Murskiy p 156–180 refs (See N66-24290 13-10)

5. ON MINIMAL REALIZATION OF CERTAIN FUNCTIONS OF SYSTEMS OF FUNCTIONAL ELEMENTS Ye. P. Soprunenko p 181–208 refs (See N66-24291 13-10)

6. SOME CONSIDERATIONS IN PROGRAMMING A CHESS GAME M. A. Yevgrafov and I. B. Zadykhaylo p 209–243 refs (See N66-24292 13-08)

7. ON SIMULATION OF MELODIES OF A GIVEN STYLE ON DIGITAL COMPUTERS R. Kh. Zaripov p 244–299 refs (See N66-24293 13-08)

8. INVESTIGATION OF TEXT SYNTHESIZED BY A COMPUTER N. G. Arsent'yeva p 300–309 refs (See N66-24294 13-08)

9. ON A VARIATION OF MORPHOLOGICAL ANALYSIS AND A METHOD OF REALIZING IT USING A SPECIALIZED COMPUTER R. A. Bazmadzhyan, T. K. Dzhanpoladyan, and T. M. Ter-mikaelyan p 310–340 refs (See N66-24295 13-08)

10. ALGEBRAIZATION OF A SET THEORY MODEL OF LANGUAGE M. Novotnyy p 341–355 refs (See N66-24296 13-19)

11. COMPLEXITY OF RECOGNITION OF SYMMETRY IN TURING MACHINES Ya. M. Barzdin' p 356–362 (See N66-24297 13-19)

12. CONSTRUCTION OF A UNIVERSAL ERROR CORRECTION FUNCTION OF TWO INPUT VARIABLES V. A. Buyevich p 363–367 refs (See N66-24298 13-19)

13. ON THE EXISTENCE OF TIGHTLY PACKED CODES V. K. Leont'yev p 368-374 refs (See N66-24299 13-08)

14. ON THE PRODUCT OF MATRIX GAMES Ye. P. Lipatov p 375-379 ref (See N66-24300 13-19)

15. ON A COMBINATORY PROBLEM Al. A. Markov p 380-384 ref (See N66-24301 13-19)

16. ASYMPTOTIC EVALUATION OF THE COMPLEXITY OF A CLASS OF SELECTION ALGORITHMS R. G. Nigmatullin p 385-395 ref (See N66-24302 13-19)

17. ON COMPARISON OF THE COMPLEXITY OF REALIZATION OF MONOTONIC FUNCTIONS BY FORMULAE TO THE BASES (γ, α) AND (γ, α, $-$) V. Ya. Pivkin p 396-403 (See N66-24303 13-19)

N66-24292# Joint Publications Research Service, Washington, D. C.

SOME CONSIDERATIONS IN PROGRAMMING A CHESS GAME

M. A. Yevgrafov and I. B. Zadykhaylo *In its* Probl. in Cybernetics 7 Mar. 1966 p 209-243 refs (See N66-24286 13-08) CFSTI: $7.08

The isolation of elementary information about a chess position and the procedural possibilities for evaluating this information on a computer were investigated. The investigation was performed under the assumption that the construction of a chess automaton is possible only on the basis of a wide and complete use of human experience, which, it is pointed out, is extremely difficult to formalize. Possible approaches to formalizing human experience, in general, and chess experience and chess theory, in particular, are discussed. Some preliminary programs and their descriptions are presented. D.T.

N66-24293# Joint Publications Research Service, Washington, D. C.

ON SIMULATION OF MELODIES OF A GIVEN STYLE ON DIGITAL COMPUTERS

R. Zh. Zaripov *In its* Probl. in Cybernetics 7 Mar. 1966 p 244-299 refs (See N66-24286 13-08) CFSTI: $7.08

Previous works on the composition and analysis of music, and the reproduction of musical sounds on a digital computer are reviewed in detail. Attempts are described to simulate, on the Ural-2 computer, the composition of tonal melodies and single voice musical productions. The possibility of formalizing such qualities as compositional style, gender, and emotional tendency are discussed. D.T.

N66-24294# Joint Publications Research Service, Washington, D. C.

INVESTIGATION OF TEXTS SYNTHESIZED BY A COMPUTER

N. G. Arsent'yeva *In its* Probl. in Cybernetics 7 Mar. 1966 p 300-309 refs (See N66-24286 13-08) CFSTI: $7.08

Several different grammars were used to generate texts on a digital computer. Three of the grammars were based on mathematical usage, and two were based on material from artistic literature. The grammars were evaluated in terms of: (1) the number of sentences or phrases produced; (2) the number of meaningful sentences produced; (3) the number of grammatically correct sentences or phrases; and (4) the probability on any given test of producing a meaningful, grammatically correct sentence. That grammar which most frequently generated correct sentences was considered to be the best. D.T.

N66-24295# Joint Publications Research Service, Washington, D. C.

ON A VARIATION OF MORPHOLOGICAL ANALYSIS AND A METHOD OF REALIZING IT USING A SPECIALIZED COMPUTER

R. A. Bazmadzhyan, T. K. Dzhanpoladyan, and T. M. Ter-Mikaelyan *In its* Probl. in Cybernetics 7 Mar. 1966 p 310-340 refs (See N66-24286 13-08) CFSTI: $7.08

An algorithm is described for performing a morphological analysis of the Russian language; and methods are proposed for using the algorithm for machine translation. The algorithm is primarily a model for word forming and word varying processes which are inherent to the usual norms of Russian word formation and word changing. D.T.

N66-24299# Joint Publications Research Service, Washington, D. C.

ON THE EXISTENCE OF TIGHTLY PACKED CODES

V. K. Leont'yev *In its* Probl. in Cybernetics 7 Mar. 1966 p 368-374 refs (See N66-24286 13-08) CFSTI: $7.08

The necessary and sufficient conditions for the existence of dense error detecting and correcting codes were established. Derivations were based on the Hemming distance function in a topological space. D.T.

N66-24304# Joint Publications Research Service, Washington, D. C.

FEEDING OF A "URAL-2" ELECTRONIC COMPUTER WITH INFORMATION OBTAINED BY MEANS OF V. M. ANAN'YEV'S MULTI-INPUT ANALYZER AND RECORDED ON ONE MAGNETIC TAPE TRACK

V. A. Mazarov 7 Apr. 1966 11 p refs Transl. into ENGLISH from Byull. Eksptl. Biol. i Med. (Moscow), no. 1, Jan. 1966 p 95-98

(JPRS-34944; TT-66-31382) CFSTI: $1.00

The method is primarily intended for processing medical and biological experimental information. Simultaneous analysis of many electrograms was accomplished by a series registration of all signals by the analyzer. It is pointed out that recording information on a single track magnetic tape insures the sufficient simplicity and reliability of the entire processing unit. Separation of number codes and control signals was achieved with the use of a marker selector. D.T.

N66-24398*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE ELECTRONICS BRAIN ON BOARD THE X-RAY TELESCOPE SPECTROMETER EXPERIMENT

H. Doong and M. Noordzy Feb. 1966 25 p

(NASA-TM-X-55461; X-611-66-70) CFSTI: HC $1.00/MF $0.50 CSCL 09C

The electronics brain on board the X-ray telescope spectrometer experiment flown on the 1965 high altitude balloon flights is discussed. A total of seven types of information from the three detectors on board the experiment is fed into the electronics brain, but only those which meet all of the prescribed conditions are permitted to be processed and recorded in a 16-track tape recorder. In addition, a real time marker is provided in the tape readout to facilitate the data reduction. Because of the complexity of the system, this paper emphasizes system operation rather than the individual circuit descriptions. Author

N66-24455# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CAN A MACHINE CREATE A DESIGN

Yu. Sinyakov 23 Sep. 1965 7 p Transl. into ENGLISH from Mosk. Pravda (Moscow), 5 Jul. 1962 p 2 (FTD-TT-65-1150/1+4; TT-65-64164; AD-622387) CFSTI: HC $1.00/MF $0.50

The use of computers for assistance in making architectural designs is related. Andrey Savchenko of the Moscow Architectural Institute is credited with using cybernetics in calculating the strength of structural slabs for roofs and for covering a winter stadium. The machine is said to be able to create design: by 'reading' an architectural sketch into a computer, an image of all possible combinations of architectural forms is attained from which a selection may be made.

TAB

N66-24520# Joint Publications Research Service, Washington, D. C.

THE AUTOMATION OF THE PLANNING OF OPTIMAL INDUSTRIAL PROCESSES

V. D. Tsvetkov *In its* Autom. Operational Management of Processes of Production 8 Apr. 1966 p 73–83 (See N66-24515 13-10) CFSTI: $7.00

The complex variational technical and economic problems involved in the planning and selection of the optimal industrial process are discussed, and it is pointed out that the greatest economic effectiveness and flexibility can be attained if the operational control is combined with industrial process regulation. Two approaches are suggested: (1) planning the possible variants of the industrial process to assure the prescribed accuracy, and to fulfill the production program by making maximum use of available plant equipment and basic materials; and (2) select from the technically possible processes that variant which assures meeting the production schedule through complete utilization of production resources at the lowest processing cost. The use of various algorithms in constructing mathematical models is discussed, and an example is given in which an algorithm is used to determine the plans for machining of shaft journals. M.G.J.

N66-24521# Joint Publications Research Service, Washington, D. C.

A MODELLING ALGORITHM FOR CONSTRUCTION OF A CALENDAR GRAPH OF PRODUCTION

S. A. Dumler *In its* Autom. Operational Management of Processes of Production 8 Apr. 1966 p 84–94 (See N66-24515 13-10) CFSTI: $7.00

In constructing a calendar graph, the timely arrival of parts at subsequent sections and a complete and coordinated production course are defined as the prime objectives. The modeling algorithm, which is shown schematically, consists of three parts: selection of the work, construction of the calendar plan, and regulation and reorganization of the reserves after each operation cycle is introduced into the graph. Details are given, and it is pointed out that, from the compiled graph, the work characteristics and the amount of idle time of the equipment are always evident. This permits developing and finding the optimal variants of the planned norms, which determine the amount of idle time and the nonintensity of the output. M.G.J.

N66-24522# Joint Publications Research Service, Washington, D. C.

THE AUTOMATIC CENTRALIZED CONTROL OF AN OPEN-HEARTH SHOP WITH COMPUTERS

M. I. Korobko, Yu. I. Samoylenko, V. I. Kozlyuk, L. V. Dzigava, and L. A. Vasheko *In its* Autom. Operational Management of Processes of Production 8 Apr. 1966 p 95–108 (See N66-24515 13-10) CFSTI: $7.00

The problems of completely automated production are discussed, with basic manufacturing processes, operational and organizational production control, and office work listed as the three principal areas of automation. A structural diagram of operational and organizational control of a shop is presented, and an algorithm is developed based on these findings. The economic aspects of optimizing the work of an open hearth shop are examined, and results show that optimality is attained at maximum productivity. The problem of dynamic planning is examined, and a system of differential equations for the course of the furnaces in the open-hearth shop is derived. M.G.J.

N66-24524# Joint Publications Research Service, Washington, D. C.

AN INSTRUCTION CODE FOR A CONTROLLING COMPUTER

E. A. Trakhtengerts and V. E. Yurchenko *In its* Autom. Operational Management of Processes of Production 8 Apr. 1966 p 120–135 refs (See N66-24515 13-10) CFSTI: $7.00

Explanatory details are given on a proposed instruction code which describes the monitoring and control process. As conditional or unconditional transfer of control is provided in the instructions, the addresses of the transfer of control are also recorded in the appropriate cells. The fixed addresses are listed, along with the designations introduced in the instructions. Five fixed instructions are also listed for describing the algorithm of monitoring and control of production. The most typical algorithms for continuous production are discussed, and block diagrams are included to amplify the text. M.G.J.

N66-24525# Joint Publications Research Service, Washington, D. C.

ESTIMATION OF THE RELIABILITY AND EFFECTIVENESS OF THE STRUCTURE OF THE INFORMATIONAL PART OF A SYSTEM OF OPERATIONAL MONITORING AND CONTROL

F. V. Babayev *In its* Autom. Operational Management of Processes of Production 8 Apr. 1966 p 136–148 refs (See N66-24515 13-10) CFSTI: $7.00

The problems connected with selecting the number of operators necessary to assure reliable operation of a monitoring and control system are reviewed, with reliability defined as the capability of the system to work without any losses of information. A random value is introduced which designates the number of parameters requiring observation by on-the-spot operators; this value can range from 0 to the total number of controlled parameters in the system. A limiting number of parameters are assumed, based on limited human capabilities to process information in a unit of time, and on the quality of information from each controlled point in the process. A solution is proposed, with the problem characterized by the following parameters: the number of operators providing a reserve to the monitoring and control system; the number of repairmen; the limiting number of parameters which one operator is able to service; the average working time of a point before failure; the average repair time; and the total number of controlled parameters in the system. M.G.J.

N66-24527# Joint Publications Research Service, Washington, D. C.

MODELS AND ALGORITHMS FOR THE OPTIMIZING OF A CHEMICAL MANUFACTURING COMPLEX

L. G. Pliskin, V. L. Volkov, and N. A. Sagaydak *In its* Autom. Operational Management of Processes of Production 8 Apr. 1966 p 199–213 refs (See N66-24515 13-10) CFSTI: $7.00

The problem of the operational optimization of a chemical manufacturing complex is examined, with the optimization based on the characteristics of the process at a given moment. The features of the mathematical model are delineated, and the equations are derived. Based on the results, it was concluded: (1) For optimizing a chemical manufacturing complex with a chain structure, a provisional optimization of each installation of the complex is sufficient. (2) In the mathematical modeling of a chemical manufacturing complex as a macrosystem, it is advisable to adopt the principle of a macrostructural or componential formation of the equations of the installations and connections between them. (3) Installation models should consist of uniform equations of a polynomial type and, if possible, should have a convex surface of the set of solutions with a concave end function. M.G.J.

N66-24530# Joint Publications Research Service, Washington, D. C.

SOME MODELS OF THE GATHERING AND PROCESSING OF DISCRETE INFORMATION IN CONTROL SYSTEMS

O. I. Bronshteyn and A. L. Raykin *In its* Autom. Operational Management of Processes of Production 8 Apr. 1966 p 245–253 refs (See N66-24515 13-10) CFSTI: $7.00

Analyses of mass servicing systems with unreliable servicing instruments are surveyed, with emphasis placed on one-step systems of operational control, and control of independent industrial objects. Problems in control system analysis are identified as investigating information flow for control of a productive process; the development of algorithms for their functioning; estimation of characteristic indicators of control system functions, such as delays and loss of information; and the establishment of the connection between those indicators on the basis of efficiency criteria. It is assumed that the quantitative characteristics of the information flows, and the algorithm of the system functions are known, and that it is necessary to estimate the main indicators of their work. Several problems are considered, mathematical models are proposed, and solutions are presented. M.G.J.

N66-24535# Joint Publications Research Service, Washington, D. C.

COMPUTER EQUIPMENT FOR THE AUTOMATIC CONSTRUCTION OF TIME GRAPHS IN OPERATIONAL CONTROL SYSTEMS

S. A. Doganovskiy and N. A. Abrosimov *In its* Autom. Operational Management of Processes of Production 8 Apr. 1966 p 301–307 (See N66-24515 13-10) CFSTI: $7.00

Details are given on the development of computer equipment for the automatic construction of graphs for 40 operations. A block diagram is presented, along with diagrams of the time graph and critical path obtained automatically in the solution of a graph with 20 operations. In parallel with the tracing of the graphic plan, the start or end of all operations were printed on an electronic digital voltmeter. In the method discussed, networks composed of resistors are used, which commutated according to a prescribed program. The length of the operations is determined by the size of the resistance, through which an unchanged quantity of direct current flows. The resistors of the network are connected in accordance with the graph through the normally open contacts of the commutators. The commutating equipment is controlled by the selected algorithm for a given program. M.G.J.

N66-24555# Lockheed Missiles and Space Co., Sunnyvale, Calif.

INFORMATION ANALYSIS USING CHART VERSIONS 3 AND 5

Apr. 1966 110 p refs
(LMSC-669737)

A general information concept is presented to demonstrate the similarity of problems in the management of both scientific and technical information. The use of computer and graphic display for processing and formatting engineering design, manufacturing, financial, technical and scientific data is considered in depth. No programming experience is assumed although access to computer facilities usual in aerospace facilities is required to implement the nine types of chan paper including log-log, probability, Weibull together with other formats useful in information analysis for pattern recognition or frequency distributions. The programs are general in nature and are not keyed to any system in producing output information for control, tracking or diagnosis. Author

N66-24589*# Honeywell, Inc., St. Petersburg, Fla. Aeronautical Div.

NASA PATTERN PROCEDURES MANUAL. PART I: APOLLO PAYLOAD EVALUATION

Joseph L. Kirk 15 Jan. 1966 99 p
(Contract NAS8-20207)
(NASA-CR-74615; AERO-8-20207-PM) CFSTI: HC $3.00/MF $0.75 CSCL 09B

An instruction manual on the use of the Planning Assistance Through Technical Evaluation of Relevance Numbers (PATTERN) technique to determine relative value of candidate space experiments is presented. The composition of PATTERN is generally defined and its application to the problem of experiment payload selection is considered. From this application a ten-level space relevance tree, based on detailed analysis of future space missions, was constructed. Appropriate mathematical relations are shown and the computer program is described. Guidelines for information updating and data management, and outputs as they apply to planning activities are also discussed. A.O.

N66-24601*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

SFPRO: SINGLE PRECISION COWELL TRAJECTORY PROCESSOR

Alan D. Rosenberg, Robert J. White, Peter S. Fisher, Raymond A. Harris, and Nicholas S. Newhall 15 Jan. 1965 229 p refs
(Contract NAS7-100)
(NASA-CR-74019; JPL-TM-33-199) CFSTI: HC $6.00/MF $1.25 CSCL 09B

SFPRO, a Single Precision Cowell Trajectory Processor, a digital computer program written for the IBM 7094 computer. Given a spacecraft ephemeris tape, SFPRO can perform tracking station view period calculations, and at specified intervals of time it can generate tracking station printouts, and relative to the Earth, the Sun, and the target body, referenced to any of several planes. SFPRO can generate a binary tape, containing a time history of the position and velocity of the spacecraft with reference to the bodies of the integration scheme, the orientation of the spacecraft with reference to as many as five tracking stations, and various auxiliary quantities. The spacecraft ephemeris contains all physical constants and other data which define the trajectory of a spacecraft. Therefore the trajectory cannot be modified by SFPRO. Herein presented are the general logic flow of SFPRO, definitions of input and output, hardware and software configurations, and interfaces of the program with the systems. Author

N66-24669# Boeing Co., Seattle, Wash. Aerospace Div.
DIGITAL SPECTRAL ANALYZER
Susan Yamamura [1964] 127 p refs
(AS-2037)

The Digital Spectral Analyzer is an FAP-FORTRAN program for the 7094, in three chain links. The program will compute the following for up to two channels: (1) auto-covariance, (2) cross-covariance, (3) power spectrum, (4) cross power spectrum (real and imaginary parts), (5) magnitude of the cross power spectrum, and (6) transfer function. Presently, data input must be in EPSCO-WEST format. Author

N66-24692*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TEN BIT ANALOG TO DIGITAL CONVERTER
Robert S. Lee Feb. 1966 17 p
(NASA-TM-X-55459; X-614-66-59) CFSTI: HC $1.00/MF $0.50 CSCL 09B

A ten bit analog-to-digital converter which is accurate to within ±1 bit of the least significant digit was developed. The converter was successfully used on a sounding rocket to monitor the temperature of a thermal sensitive optical filter, whose temperature was controlled to within ±0.1°C. Complementary four transistor flip-flops were used instead of standard two transistor flip-flops in order to conserve power. However, it is pointed out, where package size and weight have priority of power consumption, microelectronic chips can be used for all flip-flops, one-shots, and NAND gates. D.T.

N66-24731# Lincoln Lab., Mass. Inst. of Tech., Lexington.
BASELINE: A MAN-MACHINE PROGRAM FOR DATA ANALYSIS
George M. Shannon, Harold L. Kasnitz, and John A. Drumheller 20 Jan. 1966 134 p ref Tech. Note No. 1966-4
(Contract AF 19(628)-5167; ARPA Order 600)
(ESD-TDR-66-19; AD-628494) CFSTI: HC $13.60/MF $1.00

BASELINE was designed to perform a statistical analysis of radar pulse data, previously read by the laboratory's high precision computer controlled film reader. A computer controlled display oscilloscope, a light pen and a set of function coded sense switches provide a real time interface between an analyst and the data reduction program in the computer. The computer performs all necessary display, computation and outputting functions. All operations are under direct control of the analyst. He sets the operating criteria, exercises the required judgments and steers the program through the required analysis. Analytical results are quickly available and rapidly documented. Output consists of a statistical distribution of the input data displayed on a large oscilloscope. This display may easily be documented photographically. Key parameters describing the statistical distribution may be output on the typewriter at the command of the analyst. A very large saving in data reduction time results since the necessity of repeated test runs through a large computer and subsequent study of the numerical printouts is eliminated.
Author (TAB)

N66-24739# System Development Corp., Santa Monica, Calif.
THE UNSOLVABILITY OF THE RECOGNITION OF LINEAR CONTEXT-FREE LANGUAGES Scientific Report No. 1
Sheila A. Greibach 18 Aug. 1965 12 p refs
(Contract AF 19(628)-5166)
(TM-738/015/00; AFCRL-65-860; AD-628202) CFSTI: HC $1.00/MF $0.50

The problem of whether a given context-free language is linear is shown to be recursively undecidable. Author (TAB)

N66-24790# Computer Asspciates, Inc., Wakefield, Mass.
INFORMATION SYSTEM THEORY PROJECT. VOLUME II: COLLECTED RESEARCH PAPERS
Thomas E. Cheatham, Carlos Christensen, Robert W. Floyd et al Griffiss AFB, N. Y., RADC, Nov. 1965 278 p refs
(Contract AF 30(602)-3324)
(RADC-TR-65-377, Vol. II; AD-626820) CFSTI: HC $6.00/MF $1.50

This report contains the working papers developed under contract AF30(602)-3324 which was addressed to the development of a coherent mathematical foundation for information systems. Papers include Notes on Compiling Techniques and the TGS Translator Generator System by Thomas E. Cheatham, AMBIT: A programming Language for Algebraic Symbol Manipulation and Examples of Symbol Manipulation in the AMBIT Programming Language by Carlos Christianson, The Syntax of Programming Languages, A Survey, Flowchart Levels, NonDeterministic Algorithm and several algorithms and proofs of algorithms by Robert Floyd and An Environment for an Operating System by G. F. Leonard and J. R. Goodroe.
Author (TAB)

N66-24810# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
KINSTON FORTRAN II LIBRARY SUBPROGRAMS AS SIMULATION AIDS
Richard Henry Kauffman (M.S. Thesis) Dec. 1965 103 p refs
(GRE/MATH/65-6; AD-628335) CFSTI: HC $10.60/MF $0.75

This thesis developed six Kingston Fortran II library subprograms for reducing the amount of time required to program mathematical simulations with the IBM 1620. Detailed operating instructions are given for the following subprograms: Lehmer Random Number Generator, Process Point Simulations, Statistical evaluations, Integration (Simpson's Rule), Binomial coefficient and the evaluation of the cumulative normal distributions. The thesis also described, in detail, the operating instructions of a method developed for batch execution of Kingston Fortran II for the IBM 1620.
Author (TAB)

N66-24905# Weapons Research Establishment, Salisbury (Australia).
FORMATS USED IN THE W.R.E. DATA PROCESSING SYSTEM
Nov. 1965 60 p *its* Specification WRE 247, Issue 2
CFSTI: HC $3.00/MF $0.50

In the data processing system, the outputs of instruments are recorded on film or magnetic tape, and converted by special equipments known as converters to a form suitable for input to an IBM 7090 computer. This specification describes the formats used at various points in the system. The word format is treated in its loosest sense, and the data presented includes any information which the authors feel could be of use to a prospective user of the system. Author

N66-25197# Joint Publications Research Service, Washington, D.C.
INCREASE IN EFFECTIVENESS OF RANDOM BALANCE METHOD
R. I. Slobodchikova, V. L. Freydlina, E. S. Lapina, and V. V. Nalimov 4 May 1966 14 p refs Transl. into ENGLISH from Zavodsk. Lab. (Moscow), no. 1, 1966 p 53-58
(JPRS-36322; TT-66-31758) CFSTI: $1.00

A method is described for separating essential variables in preliminary experimental investigations of complex

processes which depend on a large number of parameters. Methods of dendritic strategy and an electronic computer are used in sorting out possible combinations of factors. C.T.C.

N66-25227# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
FORTRAN II PROGRAM FOR REDUCTION OF SPECTROPHOTOMETRIC REACTION KINETICS DATA
G. J. Werkema 17 Nov. 1965 28 p
(Contract AT(29-1)-1106)
(RFP-629) CFSTI: HC $2.00/MF $0.50

A computer program, ERLF, is described that computes first-, second-, and third-order reaction rate constants by reduction of spectrophotometric absorbancy data using the respective integrated rate laws. The computer output tabulates the computed rate constants (k_1, k_2, and k_3), their time products (k_1t, k_2t, and k_3t), and the number of gram-molecular-weights of starting material that have reacted, as a function of time. Author (NSA)

N66-25239# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
WIGLE-40, A TWO-GROUP, TIME-DEPENDENT DIFFUSION THEORY PROGRAM FOR THE IBM 7040 COMPUTER
M. E. Radd Dec. 1965 60 p ref
(Contract AT(10-1)-205)
(IDO-17125) CFSTI: HC $3.00/MF $0.75

The computer program WIGLE-40, a one-dimensional, two-energy-group, time-dependent diffusion theory program for the IBM 740 computer, is described. The program is restricted to one-dimensional slab geometry with zero-gradient or zero-flux boundary conditions. The number of the delayed neutron groups may be zero, one, or six. Arbitrary time-dependent changes can be made in the parameters in the diffusion equations to introduce perturbations or feedback into the system. A sample problem and a complete FORTRAN listing of the program are included. Author (NSA)

N66-25280# Joint Publications Research Service, Washington, D.C.
THE USE OF ELECTRONIC COMPUTERS FOR COMPUTING SCIENTIFIC TECHNICAL PROBLEMS
A. Jung 28 Apr. 1966 19 p refs Transl. into ENGLISH from Feingeratetechnik (Berlin), v. 15, no. 2, Feb. 1966 p 45–53
(JPRS-35222; TT-66-31659) CFSTI: $1.00

The necessity of using electronic computers for solving scientific and technological problems in industry and research is emphasized. The computer center, its library, the type of mathematical problem which can be solved on the computer, and the computer operations are briefly outlined. N.E.N.

N66-25316# Joint Publications Research Service, Washington, D. C.
STUDIES IN MAN-MACHINE RELATIONSHIPS
A. N. Rayevskiy et al 9 May 1966 21 p Transl. into ENGLISH from selected Russian periodicals
(JPRS-35410; TT-66-31846) CFSTI: $1.00

CONTENTS:
1. MAN AND MACHINE A. N. Rayevskiy and A. V. Antonov p 1–7
2. COMPUTER USE SHOULD BE EXPANDED F. Goranskiy p 8–14

N66-25353# Atomics International, Canoga Park, Calif.
CHAD—CODE TO HANDLE ANGULAR DATA
R. F. Berland 31 Dec. 1965 88 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11231) CFSTI: HC $3.00/MF $0.75

The computer code CHAD was written as part of the effort to automate the analysis of data for the Cross Section Analysis and Applications Project. The program accepts differential scattering data in various formats, specified as a function of energy and angle; and converts this information to a Legendre expansion compatible with the Atomics International Evaluated Nuclear Data File (AIENDF). CHAD also accepts tabulated Legendre coefficients in any one of several normalizations, and converts this to the AIENDF format. One of the major features of CHAD is the recursive method for calculating the transformation matrices which convert Legendre coefficients from one frame of reference (laboratory or center of mass) to the other. CHAD permits rapid inspection of input and output data by means of an automatic graphical display package. Author (NSA)

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N66-23887# Lincoln Lab., Mass. Inst. of Tech., Lexington.
THERMAL CRACKING OF WAVEGUIDE WINDOWS
Charles E. Muehe 9 Feb. 1966 12 p refs *Its* Tech. Note 1966-19
(Contract AF 19(628)-5167)
(ESD-TDR-66-34; AD-628907) CFSTI: HC $1.60/MF $0.50

A theory is derived to explain the cracking of waveguide windows due to stresses generated by heat dissipated in the window when subject to the rf fields in a waveguide. Calculations of the temperature rise and power-handling ability of half-wavelength block windows at X-band are presented. Author (TAB)

N66-23919# ITT Corp., Easton, Pa. Electron Tube Div.
PRODUCTION ENGINEERING MEASURE FOR A PHASE II SUPER POWER HYDROGEN THYRATRON TUBE Progress Report, 7 Jun. 1964–6 Sep. 1965
H. E. Krefft 6 Sep. 1965 66 p
(Contract DA-36-039-SC-85985)
(AD-629287) CFSTI: HC $3.00/MF $0.75

During the quarterly periods covered by this report, the Phase II test modulator was completely assembled and initial operating difficulties evident during this time were overcome. As a result, the program which had been delayed by lack of this test facility was finally able to proceed and tests and evaluation of three prospective pre-production tubes were carried out. These tests show that the voltage and power capability of the original design A of the 8301/KU275 tube may have limitations at the level prescribed in Specification SCL-7001/60. At a repetition rate of 4000 pps, maximum attainable power was 128 KW at epy=40 KV, I_b=6.4 Adc. Evaluation of the test material leads to the conclusion that this limited performance is primarily due to insufficient recovery and relatively

poor hold-off in the discharge gaps which could be improved by changing the grid structures. No evidence was found of detrimental thermal effects at, or mechanical failure of, the grids. The program for the continuation of work on this contract is, therefore, aimed at the optimization of the grid structures and improved processing of the tubes during construction and aging. As a back-up program, if operation at full specified power and voltage cannot be achieved with these improvements in design A, the merits of adding a third gap to this design will be investigated. Author (TAB)

N66-23934# General Electric Co., Irmo, S. C. Electronic Speciality Capacitor Business Section.

PRODUCTION ENGINEERING MEASURE FOR IMPROVED RELIABILITY OF HERMETICALLY SEALED TANTALUM FOIL CAPACITORS Quarterly Report, 20 Sep.–20 Dec. 1965

R. M. Trewhella [1965] 21 p

(Contract DA-36-039-AMC-06169(E))

(QR-1; AD-629385) CFSTI: HC $1.00/MF $0.50

A 2.7.4 Fractional Factorial Experimental Design was selected for the evaluation of seven product design and modification factors. The special units were designed and the fabrication was started on all sixty-four lots while fourteen production lots completed manufacturing during this period. The evaluation program on the heliarc weld process resulted in a complete revision of a weld stations and the installation of an electrode positioner and support fixture with improved operator control. Author (TAB)

N66-23940# Cornell-Dubilier Electronics Div., Federal Pacific Electric Co., Norwood, Mass.

PRODUCTION ENGINEERING MEASURE FOR CAPACITORS, FEED-THROUGH, SOLID ELECTROLYTE TANTALUM PELLET Quarterly Report, 1 Oct.–31 Dec. 1965

W. G. Bailey [1965] 21 p ref

(Contract DA-36-039-AMC-03630(E))

(QR-7; AD-629199) CFSTI: HC $1.00/MF $0.50

Qualification testing of preproduction samples was continued into this quarter. Group II tests (shock, vibration, salt spray, temperature and immersion) were completed and there were no failures. Group V test (life) completed 2017 hours. There was only one unit that failed the life test (a short at 1373 hours) under normal operating conditions of 35 vdc, 85°C. This is exclusive of the failures lost due to oven overheating. Author (TAB)

N66-23982# California Univ., Berkeley. Electronics Research Lab.

SEMICONDUCTOR INTEGRATED OSCILLATORS

G. D. Hachtel 31 Aug. 1965 216 p refs

(Contract AF 33(615)-1045; Grants AF-AFOSR-139-64; AF-AFOSR-139-65)

(ERL-65-32; AD-629578) CFSTI: HC $6.00/MF $1.25

The realization of oscillation in monolithic semiconductor integrated circuits was considered. A procedure was developed for the synthesis of integrable, near-harmonic, oscillators from known, integrable, bistable circuits. By the insertion of resistors, capacitors, and batteries, the procedure converts the integrable bistable circuits into 'inductorless' oscillators. Experimental integrated realizations of oscillators synthesized were fabricated. TAB

N66-24018# Radio Corp. of America, Camden, N. J. Applied Research.

MICROELECTRONIC SOLID-STATE DISPLAY ASSEMBLY Interim Development Report, 1 Dec. 1965–1 Mar. 1966

[1966] 30 p

(Contract NObsr-93320)

(IDR-3; AD-629596) CFSTI: HC $2.60/MF $0.50

Configuration and fabrication studies on CdSe-E1 display panels were carried out. These studies were concerned with the removal of large particles from CdSe powder. Temperature tests on one of the panels, increase in binder content, use of different sizes and types of wire electrodes, tape-separated CdSe, two levels of triggering, and the effect of light on the cutoff voltage. Post-fire treatments involving atmosphere, temperature, humidity and light established that the proper treatment can improve the operation of the CdSe. It has been found that some degree of isolation between the elements of the CdSe-E1 panel is required to eliminate crosstalk. Author (TAB)

N66-24040# General Electric Co., Daytona Beach, Fla. Apollo Support Dept.

A PRACTICAL APPROACH TO THE DETERMINATION OF ELECTRICAL SUPPORT EQUIPMENT TEST REQUIREMENTS WHICH ASSURE PROPER OPERATION IN HIGH STRESS SERVICE ENVIRONMENT

James M. Ray and Edwin B. Blanford *In* NRL The Shock and Vibration Bull., No. 35, Pt. 3 Jan. 1966 p 235–242 refs (See N66-24020 13-32) CFSTI: HC $6.00/MF $1.50

A plan is presented for a test program to provide data for evaluating the capability of electronic equipment to perform in an acoustical and vibrational environment generated by large launch vehicles. The program also provides an estimate of the service life of the equipment in that environment. The features of the plan are: (a) the establishment of realistic test specification levels for each equipment location, (b) representative test of support equipment by structural classification, (c) investigation of structural properties of support equipment including resonant frequency, resonant amplification and bandwidth, and service life, (d) determination of operational performance under stress, and (e) modification of operational equipment to the qualified design configuration at a convenient time to minimize schedule and cost impact. C.T.C.

N66-24041# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

HIGH IMPACT SPACECRAFT EQUIPMENT

J. L. Adams and M. G. Comuntzis NRL The Shock and Vibration Bull., No. 35, Pt. 3 Jan. 1966 p 243–258 refs (See N66-24020 13-32) CFSTI: HC $6.00/MF $1.50

(Contract NAS7-100)

This paper, in addition to discussing design philosophies and test equipment, presents details on an impact-resistant gas chromatograph, an impact-resistant S-band transmitter, and various mechanism elements and devices which have been built. Development test results are included where pertinent. The goal of the high impact program is to investigate all types of equipment with possible application in landing systems. Results to date indicate that it is feasible to build spacecraft-type equipment capable of surviving impacts on the order of 10,000 g's from several hundred feet per second. Author

N66-24042# Boeing Co., Seattle, Wash. Airplane Group.

EVALUATION OF ACOUSTIC ENVIRONMENTAL EFFECTS ON FLIGHT ELECTRONIC EQUIPMENT

J. Sugamele *In* NRL The Shock and Vibration Bull., No. 35, Pt. 3 Jan. 1966 p 259–279 refs (See N66-24020 13-32) CFSTI: HC $6.00/MF $1.50

This paper discusses briefly the structural response characteristics of typical electronic components to intense acoustic

environments. Available electronic component and flight package acoustic test data obtained from the literature and testing experience are classified and presented according to their function and structural characteristics. A discussion is given on the acoustic sensitivity of the equipment items in each category. From this body of information, a procedure is suggested which outlines the steps for evaluating electronic equipment which is required to function in severe acoustic environments. The acoustic test data presented shows that acoustically induced vibration of equipment chassis cover panels and support structure is the main cause of equipment malfunctions. Equipment items most susceptible to malfunction are those (a) components whose function involves motion of flexible parts (e.g. relays, pressure switches, etc), and (b) components which contain relatively flexible structural parts and are nominally stationary (e.g. vacuum tubes, piezoelectric devices, etc.). Author

N66-24082# General Electric Co., Lynchburg, Va. Communication Products Dept.
MICROMINIATURE CRYSTAL UNIT TYPE CR-(XM-47)/U, PRODUCTION ENGINEERING MEASURE Second Quarterly Progress Report
R. L. Hatcher and R. D. Laney [1965] 36 p
(Contract DA-36-039-AMC-06166(E))
(QPR-2; AD-628337) CFSTI: HC $2.00/MF $0.50

Progress in the second quarter resulted in the shipment of Engineering Sample No. 2 and preparation of facilities and procedures for manufacturing the production units. Manufacturing facilities installation and tooling development is on schedule. The quality control equipment was delivered to this location and will be complete when required for pre-production samples. Manpower requirements were finalized and the personnel needed made available. Author (TAB)

N66-24083# Ling-Temco-Vought, Inc., Dallas, Tex. LTV Vought Aeronautics Div.
INVESTIGATION OF CONTACTLESS SWITCHING CONCEPTS FOR APPLICATION TO AIRCRAFT ELECTRICAL SYSTEMS. VOLUME VI: FLIGHT TEST EVALUATION OF A PROTOTYPE CONTACTLESS SWITCHING SYSTEM, PHASE VI Final Engineering Report, 15 Aug. 1964–15 Jan. 1966
A. J. Marek 15 Jan. 1966 108 p refs
(Contract N600(19)-62121)
(Rept.-2-53727/6R449-6; AD-628581) CFSTI: HC $11.60/MF $0.75

A program was conducted which included the design, fabrication, installation and flight testing of a prototype 'Contactless Switching' system with a capability of controlling a limited number of electrical circuits in an F-8 type airplane. Prototype hardware and the system package were operationally checked in the laboratory, and an operational performance record of the flight evaluation was maintained. 'Proposed' Military Standard Specifications were prepared for hardware comprising the 'Contactless Switching System'. Author (TAB)

N66-24363# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BALANCED MIXER
V. A. Libin and B. P. Prokhorenkov 15 Nov. 1965 5 p Transl. into ENGLISH from Soviet Patent no. 165799 (Appl. no. 756200/26-9, 18 Dec. 1961) 2 p
(FTD-TT-65-996/1+2+4; AD-625287) CFSTI: HC $1.00/MF $0.50

A balanced mixer designed on two rectangular waveguides which has the end part of the heterodyne waveguide connected to the wide wall of the signal waveguide. The plane E of the signal waveguide is parallel to the plane H of the heterodyne waveguide and the connection of the heterodyne waveguide with the diodes is accomplished with a symmetrical loop of magnetic connection. TAB

N66-24404*# Battelle Memorial Inst., Columbus, Ohio.
A STUDY OF THE RELIABILITY OF ELECTRONIC COMPONENTS IN A NUCLEAR-RADIATION ENVIRONMENT Thirteenth Quarterly Progress Report, 1 Jan.–31 Mar. 1966
Donald J. Hamman 15 Apr. 1966 10 p Prepared for JPL Its Monthly Progr. Rept.-40
(Contracts NAS7-100; JPL-950458)
(NASA-CR-74631) CFSTI: HC $1.00/MF $0.50 CSCL 09A

Environmental tests were completed and final measurements on electronic components exposed to a total of 9633 hours of radiation are reported for test groups III, V, and VI. Component parts in all tests had received about 11,744 hours of operational load, in addition to 100 hours of operation and high flux radiation exposure of the parts in test group IV. The enclosed tables summarize the radiation exposure of test groups III, V, and VI through 9633.0 hours to neutron and gamma irradiation, and show the recorded failures of the transistors. G.G.

N66-24668# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
ANNEALING OF NEUTRON DAMAGE IN SILICON TRANSISTORS—A NOVEL HARDENING TECHNIQUE
B. J. Donaldson Aug. 1965 100 p refs
(SM-47844)

This report describes a study to determine the feasibility of employing in situ annealing as a radiation hardening technique for permanent damage in solid-state devices operating in a severe nuclear environment. The program began with annealing studies made using transistors irradiated in a concurrent program to develop radiation resistant digital circuits. In these preliminary studies a molten tin bath was used to provide accurate temperature control and annealing times. The isothermal and isochronal annealing results obtained using this method provided the information needed for a nuclear irradiation test. This reactor test successfully demonstrated the possibility of using an insitu annealing technique, in this case remotely controlled heating coils, to repeatedly rejuvenate a transistor severely damaged in an intense neutron environment. It was possible to extend the useful life of these devices by almost two orders of magnitude using this technique. Author

N66-24729# Naval Avionics Facility, Indianapolis, Ind. Applied Research Dept.
THE COMPUTER ORIENTED DESIGN OF ELECTRONIC DEVICES (CODED) PROJECT—REVISED PROGRAM FOR POWER TRANSFORMERS
John A. Ottlinger and John P. Staples 20 Jan. 1966 63 p refs
(NAFI-TR-774; AD-628535) CFSTI: HC $3.00/MF $0.75

This report explains the purpose, background, and applications of the Computer Oriented Design of Electronic Devices program (CODED) for avionic power transformers. It also describes the purpose, need, and techniques of the transformer component standardization effort. The report is intended to acquaint the reader with the CODED project and provide enough information so that a transformer designer may use

the program successfully. It is also intended to illustrate the benefits of using digital methods as a tool in the solution of engineering design problems. Author (TAB)

N66-24768# Autonetics, Anaheim, Calif. Research and Engineering Div.

A STUDY OF MILITARY ELECTRONIC AND ELECTROMECHANICAL SPECIFICATION PART IDENTIFICATION REQUIREMENTS Final Report, 1 Dec. 1964–30 Jun. 1965

D. E. Brown and R. H. Carter Griffiss AFB, N. Y., RADC, Feb. 1966 64 p refs

(Contract AF 30(602)-3590)

(RADC-TR-65-273; AD-629544) CFSTI: HC $3.00/MF $0.75

Part Marking: Lack of uniform requirements for marking of military parts together with the progressive decrease in size of electronic components presents problems in identifying components for replacement and failure analysis. A uniform system of marking is recommended which is based on the Federal Supply Code (H4-1), Date Code (MIL-STD-456) and the part number recommended in Section B (Part Numbering) of this report. Part Numbering: There is little consistency in the method of creating identifying part numbers in military specifications. Industry is divided between favoring significant or nonsignificant part numbers. This study, initiated to analyze existing and potential numbering systems, has resulted in a recommendation that a uniform system be established based on the specification number. The recommendation includes provisions for both partially significant and nonsignificant dash numbers depending upon the situation. Author (TAB)

N66-24787# New York Univ., N. Y. Lab. for Electroscience Research.

MICROELECTRONIC AMPLIFIERS HAVING MINIMUM SENSITIVITY TO ARBITRARY PARAMETER CHANGES Twenty-First Scientific Report

John J. Golembeski, Mohammed S. Ghausi, James H. Mulligan, Jr., and Sidney S. Shamis Oct. 1965 28 p refs Presented at the Natl. Electron. Conf., Oct. 1965 *Its* Tech. Rept.-400-119

(Contract AF 19(628)-379)

(AFCRL-65-802; AD-625379) CFSTI: HC $2.00/MF $0.50

The ease and low cost of fabricating large numbers of transistors in microelectronic configurations make feasible the use of redundant active devices to achieve improved reliability and decreased sensitivity to parameter changes. This paper considers an amplifier configuration which has particular advantages for microcircuit realization. The arrangement described is capable of yielding a fractional gain change which is equal to the product of the fractional deviations in the gains of each of the redundant signal channels. The nominal input-output transmission is maintained, with negligible changes in gain and bandwidth, even with complete failure of one or more (but not all) of the signal channels; this is achieved at the expense of an increase in sensitivity. The sensitivity to large parameter changes can be mimimized over an appreciable portion of the amplifier passband by use of the systematic design procedure which is presented. Experimental verification of theoretical predictions and the design procedure is included. Author (TAB)

N66-24798# General Electric Co., Syracuse, N. Y. Electronics Lab.

MAGNETO-OPTICAL DISPLAY PANEL WITH MEMORY First Quarterly Report, 1 Jul.–30 Spe. 1965

J. E. Eide, R. E. Glusick, L. E. Somers, and H. F. Windsor Jan. 1966 24 p

(Contract DA-28-043-AMC-01442(E))

(ECOM-01442-1; AD-629586) CFSTI: HC $2.60/MF $0.50

The program is based upon Bitter solution overlays on electrodeposited Ni–Fe magnetic films. This results in a magnetically rotatable grating on the film which can be optically interrogated. Useful and moderately efficient films were produced, electronic address, write and erase circuitry were evolved, and a coincident current writing at the required spatial density was demonstrated. A number of potential problems were recognized and future effort was planned accordingly. Author (TAB)

N66-24799# Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.

TECHNIQUES FOR MICROWAVE COMPONENTS OF REDUCED WEIGHT

Irwin J. Steinhardt, Hyman Plutchok, Mark Hurowitz, and Daryl W. Shipley 9 Nov. 1965 42 p ref

(Contract DA-28-043-AMC-00379(E))

(EDL-M888; AD-629930) CFSTI: HC $2.00/MF $0.50

During the period of this report consideration was given principally to waveguide components in X-band which are inherently heavy and bulky. A substantial saving in weight can be accomplished if the relatively heavy waveguide walls and flanges which confine the microwave energy are replaced by thin metal surfaces which are supported mechanically by lightweight materials. Two methods for this support have been investigated. The results achieved from microwave resonators fabricated by these two means are presented in this technical memorandum. In addition there has been a study of foam-in-place techniques with polyurethane foam and the effects of loading the foam with high dielectric constant fillers. The results of this work are also reported in this memorandum. To fabricate the resonators mentioned above involves the development of molding techniques which are described in the text. The techniques evolved on this program permit the fabrication of structures with very close tolerances. TAB

N66-24803# Bowles Engineering Corp., Silver Spring, Md.

ANALYSIS AND TEST OF A SIGNAL TRANSMISSION IN A MULTIPHASE FLUID MIXTURE

R. E. Bowles and F. M. Manion Fort Eustis, Va., Army Aviation Materiel Labs., Jan. 1966 47 p ref

(Contract DA-44-177-AMC-202(T))

(USAAVLABS-TR-65-77; AD-628676) CFSTI: HC $2.00/MF $0.50

Analytic studies and experimental measurements of the velocity of sound in a two-phase mixture of gas and liquid were performed to provide a basis for analyzing performance of fluid computing networks with multiphase fluids and to stimulate the application of such conditions to fluid computation. In particular, the work was directed toward the investigation of mixtures with a large percentage of gas, a regime where little experimental data has been available. The analytic studies include a review of the classical approach to wave propagation and attenuation, which pertains to a homogeneous mixture, and a development of an analytic model consisting of layers of gas and liquid normal to the flow direction for the non-homogeneous case. Calculations based on this model show that the speed of sound and attenuation in a two-wave mixture having high gas content depend on the detailed nature of the mixture. This is borne out by the experiment. Author (TAB)

N66-24804# Lenkurt Electric Co., Inc., San Carlos, Calif.
AMPLIFIER ASSEMBLY (AM-4006()/FCC-17) (SUPERGROUP CARRIER AMPLIFIER) Technical Report, Phase B
Forrest N. Easley 21 Jan. 1966 27 p refs
(Contract AF 30(635)-11188)
(RADC-TDR-63-507, Vol. II; AD-628158) CFSTI: HC $2.60/MF $0.50

This report contains a chronological summary of fabrication and Category I Testing of Amplifier Assembly AM-XXXX (XW-1)/FCC-17. The Amplifier Assembly was designed to increase the load capability of up to six supergroup carrier frequencies. Author (TAB)

N66-24808# CTS Corp., Elkhart, Ind. Research and Development Div.
PRODUCTION ENGINEERING MEASURE FOR SUBMINIATURE, TRANSISTOR TYPE POTENTIOMETERS Quarterly Progress Report, 1 Jul.–30 Sep. 1965
C. L. Holmes and D. C. Kinsey [1965] 12 p
(Contract DA-36-039-SC-85976E)
(QPR-17; AD-628280) CFSTI: HC $1.00/MF $0.50

Technical Action Request No. 8 was submitted to request changes in test requirements. These requested changes were denied. After reviewing the entire project, the decision was made to rebuild the 300 controls as proposed in Action II, TAR No. 8. Fabrication of the 300 controls was begun and a new time table was submitted to the Signal Corps for approval. TAB

N66-24818# Motorola, Inc., Phoenix, Ariz.
PRODUCTION ENGINEERING MEASURE FOR SILICON LINEAR INTEGRATED CIRCUITS Quarterly Progress Report, 20 Jul.–20 Oct. 1965
Robert Mc Ginnis, Thomas Quaid, and Thomas Monaghan Jan. 1966 22 p
(Contract DA-36-039-AMC-06158(E))
(QPR-2; AD-628990) CFSTI: HC $1.00/MF $0.50

This report describes the work accomplished during the second quarterly period in the effort to produce silicon linear integrated circuits of the type used in FM receivers. During this interval, the effort was devoted to developing the receiver front-end circuits; i.e., the circuits which preceded the i-f filter. These include the r-f amplifier, the first and second mixers, and the first and second local oscillators. The five integrated circuits which performed these functions in the demonstration radio, Contract DA-28-043-AMC-00150 (E), are replaced by three monolithic IC's of the following description: (1) RF Amplifier: Electrically identical to the IC 732 except for IC layout and pin arrangement. (2) First Mixer-Oscillator: Monolithic IC containing both mixer and oscillator circuitry. (3) Second Mixer Oscillator: Identically the same chip as used in the first mixer-oscillator; modified only by external connections. The evaluation of the i-f amplifier (IC 977) and the integrated circuit processing of the audio and limiter squelch IC's was continued during this reporting period. Author (TAB)

N66-24821# Radio Corp. of America, Somerville, N. J.
DEVELOPMENT OF A GALLIUM ARSENIDE METAL-OXIDE SEMICONDUCTOR TRANSISTOR Final Technical Documentary Report, 6 May 1963–5 May 1964
H. Becke, R. Hall, and J. P. White Wright-Patterson AFB, Ohio, AF Avionics Lab., Jul. 1964 101 p refs
(Contract AF 33(657)-11402)
(AL-TDR-64-146; AD-602440) CFSTI: HC $4.00/MF $0.75

The work described was intended to demonstrate the feasibility of using gallium arsenide for MOS transistors and to develop a process for the production of a few specific samples. The major problem posed by the development of a useful gallium arsenide MOS transistor was the reduction of the state density at the oxide–gallium arsenide interface. The surface varactor was used, as a test vehicle, in the investigation of this interface. Low interface state densities were obtained, and incorporated into the oxide deposition process. A technique for producing low surface concentration n-type diffusions was then developed and used to fabricate devices. The characterize these devices, a model similar to that proposed for the field effect transistor was extended to include the effect of interface states. The report includes a detailed description of the process developed for the fabrication of n-channel depletion type gallium arsenide MOS transistors. Electrical measurements made on several experimental devices are described, and the average mobility of negative charges at the gallium arsenide surface is calculated from the device characteristics. A comparison is made of the characteristics of a gallium arsenide device with those of a typical silicon device, having the same geometry. Author (TAB)

N66-24945*# Westinghouse Electric Corp., Baltimore, Md. Defense and Space Center.
A REDUNDANT SPACECRAFT SEQUENCER BREADBOARD Phase I Report, Dec. 22, 1965–Mar. 30, 1966
[1966] 15 p Prepared for JPL
(Contracts NAS7-100; JPL-951345)
(NASA-CR-74675) CFSTI: HC $4.00/MF $0.75 CSCL 09C

The design detail was completed for the implementation and testing of a redundant spacecraft sequencer breadboard, which is a version of a portion of the Mariner C spacecraft sequencer. The breadboard model is to be used to verify the results of a previous study to design a redundant multiple logic version of the spacecraft central computer and sequencer. The model includes the electrical equivalent of a significant portion of the entire redundant sequencer. Low density packaging was used to reduce costs and to permit a comprehensive test program. The circuitry is a combination of integrated and discrete component circuits. D.T.

N66-24949*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
INTEGRITY OF ELECTRICAL CONNECTIONS Completion Reports for Subtasks d, e, f, and g
L. D. Brown Dec. 1965 164 p
(Contract NAS8-11475)
(NASA-CR-74744; LMSC-A764519) CFSTI: HC $5.00/MF $1.00 CSCL 09A

The results and recommendations of four subtasks involved with an investigation of integrity of electrical connections are presented. The subtasks were conducted (1) to develop information on the behavior of plastic materials for storage bags or containers for solder coated printed circuit boards or component parts with solder coated leads; (2) to determine optimum clearance between a solder connection and insulation; (3) to investigate the possible damage which could result when molten solder wicks under cable insulation, and to establish a limit for wicking above and below insulation if the condition proves to be harmless; and (4) to determine the effect of stranded wire plating and insulation on the pull strength of soldered joints. R.N.A.

N66-24951*# Texas Instruments, Inc., Dallas. Semiconductor-Components Div.
DESIGN, DEVELOPMENT AND DELIVERY OF ONE (1) BREADBOARD AND THREE (3) PRODUCTION UNITS OF A 75 VA INTEGRATED STATIC INVERTER Monthly Progress Report No. 10, Feb. 1966
J. P. Vergez, L. A. Hahn, L. L. Glover, and P. F. Newcomb [1966] 14 p
(Contract NAS8-11925)
(NASA-CR-74763; SC0301-366) CFSTI: HC $1.00/MF $0.50 CSCL 09A

During this period variable duty cycle one-shot masks were received from the photo shop. Temperature tests were performed on the complete breadboard. Additional circuit modifications are needed to improve circuit operation at the temperature extremes. Several types of inductor potting compound are being considered. The power transformers were reduced in size by using the next smaller core and wire size. Initial material was processed and tested on the ÷10, ÷12, and flipple counter arrays. The interconnection mask was modified to assure high temperature operation. The first lot of new materials is being tested. Oxide removal masks for the Johnson counter array are being checked for alignment. The contact and metallization maks for the Johnson counter are being processed. A satisfactory method of alloying the silicon chip to the header was achieved. Fabrication of power devices is proceeding on a limited scale. Author

N66-24974*# Northeastern Univ., Boston, Mass. Communications Research Group.
[UTILIZATION OF INFORMATION THEORY IN DIGITAL DATA GUIDANCE SYSTEMS] Quarterly Progress Report No. 1, 1 Sep.–30 Nov. 1965
Sze-Hou Chang 10 Dec. 1965 19 p refs
(Grant NGR-22-011-013)
(NASA-CR-74690) CFSTI: HC $1.00/MF $0.50 CSCL 09D

Theoretical analyses were conducted to demonstrate how the range, capacity, reliability, and efficiency of a digital data transmission system can be improved. Summaries are presented of the results of studies in the areas of data rate versus intersymbol interference, the design of orthogonal codes, error control codes, and a technique for bandwidth compression in telemetry. A model digital transmission system was studied and it was concluded that in some cases it is profitable to increase the transmission rate to the point where some intersymbol interference is created. A method of evaluating that rate which optimizes channel capacity is presented. Means of constructing orthogonal codes by pseudo-random sequence, inspection and a recursive method are described. The implementation of error codes is demonstrated. It is stated that if the parity check matrix elements are allowed to be expressed first in the extension fields of the binary field, and then translated back to the binary field, more varieties and more efficient codes may result. H.S.W.

N66-25122# Edgerton, Germeshhausen and Grier, Inc., Las Vegas, Nev.
SUPERCONDUCTING HIGH VOLTAGE DELAY LINE
A. J. Cummings and H. Kuettner (HiTemp Wires, Co.) 19 Nov. 1965 30 p refs Presented at the 14th Ann. Symp. on Wire and Cable, Atlantic City, 1–3 Dec. 1965 Prepared jointly with HiTemp Wires Co.
(Contract AT(29-1)-1183)
(EGG-1183-1192; CONF-651203-1) CFSTI: HC $2.00/MF $0.50

Various types of coaxial cables with superconducting properties were evaluated for both low voltage and high energy pulse propagation. A relationship between pulse widths and voltage levels was observed and their effect on maximum energy propagation was analyzed. A summary of earlier evaluations is given. A new cable construction with a pure niobium inner conductor, Teflon FEP dielectric and a thin tubular layer of high purity lead has shown superior properties as compared to the other types. Voltages up to 5 kv and pulse widths up to 4 microseconds were transmitted at 4.2°K over a length of 1040 feet with a line response of approximately 0.39 nanoseconds. This is an unprecedented rise time commensurate with high voltage capabilities. The characteristics impedance throughout the line is controlled to within less than ±1% in a 50 ohm system resulting in very low reflexions and less than 1/2 db signal attenuation for the 1040 foot test length including nonsuperconducting lead-ins. Possible applications in different fileds are shown and the basic performance parameters discussed. Author (NSA)

N66-25270# Sprague Electric Co., North Adams, Mass.
PRODUCTION ENGINEERING MEASURE FOR MECHANIZATION OF HIGH-RELIABILITY CAPACITORS Quarterly Report, Sep. 31–Dec. 30, 1965
J. H. David Folster and G. E. Walters 31 Mar. 1966 20 p refs
(Contract DA-36-039-AMC-01460(E))
(QR-12; AD-630437) CFSTI: HC $1.00/MF $0.50

Work during this period consisted of making additional modifications to the machines in order to optimize their efficiency. TAB

N66-25271# Sprague Electric Co., North Adams, Mass.
PRODUCTION ENGINEERING MEASURE FOR IMPROVED RELIABILITY OF SOLID ELECTROLYTE TANTALUM CAPACITORS Quarterly Report, Sep. 29–Dec. 29, 1965
J. H. D. Folster and E. J. Fresia [1965] 12 p refs
(Contract DA-36-039-AMC-03621(E))
(QR-10; AD-630253) CFSTI: HC $1.00/MF $0.50

The 10,000-hr life test of 9150 capacitors of nine different ratings has reached the 2000-hr point. Readings from a statistically randomized sample are presented.
Author (TAB)

N66-25274# Sylvania Electric Products, Inc., Woburn, Mass. Semiconductor Div.
PRODUCTION ENGINEERING MEASURE (PEM) FOR SILICON VARACTOR DIODE Quarterly Progress Report, 1 Oct.–31 Dec. 1965
G. Browne and R. Bayliss [1965] 60 p
(Contract DA-36-039-AMC-06159(E))
(QPR-3; AD-630196) CFSTI: HC $5.60/MF $0.75

Group B tests, were completed on units from the Second Engineering Test Sample Run. Process changes were made during the quarter to incorporate the use of silicon junctions of the planar structure for the Third Engineering Test Sample Run as opposed to the mesa structure used for fabrication of units in the first two runs. Preliminary tests on units from the third run indicate considerable improvement particularly in regard to thermal resistance characteristics, uniformity of parameter distributions, and ability to withstand high temperature storage testing. Author (TAB)

N66-25308*# Johns Hopkins Univ., Baltimore, Md.
A TECHNOLOGY OF TUNNEL DEVICES FOR MILLIMETER-WAVE APPLICATIONS

L. E. Dickens Washington, NASA, May 1966 80 p refs
(Contract NAS5-3546)
(NASA-CR-497) CFSTI: HC $3.00/MF $0.75 CSCL 09A

This report describes the development of tunnel diode fabrication techniques and circuits for millimeter wave receivers with improved sensitivity. Emphasis is placed on details of the experimentally and empirically determined procedures used in fabricating the tunnel devices which have so far been effective up to 70 gc. The method used to dope the semiconductor to the level of degeneracy required by the point contact diodes is described. A remelt process is used to effect the necessary mixing. Fabrication details of the complete devices are presented along with a discussion of the various epoxy resins and combinations of resins used to encapsulate and ruggedize the point contact assembly. The procedure is given for electrically forming the junction between the point contact wire and the appropriate semiconductor material. The equipment used to monitor the metal to semiconductor contact and the subsequent junction forming is described. Some of the results obtained with the diodes constructed according to these procedures are outlined and some of the diode holders and other circuitry in which the diodes are tested are shown.
R.N.A.

N66-25342# Sandia Corp., Albuquerque, N. Mex.
TRANSITOR OSCILLATORS EMPLOYING PIEZOELECTRIC CERAMIC FEEDBACK NETWORKS
C. E. Land Mar. 1965 18 p refs Presented at IEEE Intern. Conv., New York
(Contract AT(29-1)-789)
(SC-R-65-855; CONF-650320-1) CFSTI: HC $1.00/MF $0.50

A technique for using a two or three port ferroelectric ceramic resonant structure as an integrated oscillator feedback network is described. Advantages of an oscillator circuit employing this type of feedback network are discussed. The basic oscillator, equivalent circuits of the feedback networks, a method of measuring the equivalent circuit components, the criteria of oscillation, and characteristics of both fixed frequency and variable frequency oscillators are discussed.
NSA

N66-25344# Sandia Corp., Albuquerque, N. Mex.
A STUDY OF THE NEUTRON-INDUCED BASE CURRENT COMPONENT IN SILICON TRANSISTORS
C. A. Goben Jul. 1965 19 p refs Presented at IEEE Ann. Conf. on Nucl. and Space Radiation Effects, Ann Arbor, Mich., 12–15 Jul. 1965
(Contract AT(29-1)-789)
(SC-R-65-912; CONF-650707-4) CFSTI: HC $1.00/MF $0.50

In a previous paper a neutron-induced component of base current was reported that increases in proportion to integrated neutron flux and varies with base-to-emitter voltage, V_{BE} as exp. $\frac{q}{nkT} V_{BE}$ n being approximately 1.5. A component of base current which varies similarly with base-to-emitter voltage has previously been reported to be of surface-perimeter origin. For this reason it is significant to unambiguously locate the origin of the neutron-induced component. For this, a detailed study of the current-voltage characteristics, an analysis of the deviation of the characteristics from an exponential caused by emission concentration for "ring-dot" structures, and an analysis for the transverse bias dependence of the base current components for a special "tetrode-type" test structure were performed. The results indicate that the small "1.5 component" of current initially present is indeed of surface-perimeter origin while the added"1.5 component" of current induced by neutron bombardment is of bulk space charge region origin. To determine whether this effect is universal, an investigation was made of many different types of silicon transistors, and all were found to exhibit a similar neutron-induced current component. The number n in the exponential term is found to be a function of temperature decreasing with increasing temperature. For example at −50°C, n=1.6, and at +100°C, n=1.3. Annealing studies reveal an apparent difference in annealing rates for the neutral bulk base region and the high-field region of the emitter-base junction.
Author (NSA)

N66-25379# Army Electronics Labs., Fort Monmouth, N. J.
A STUDY OF VOLTAGE BREAKDOWN PHENOMENA IN THE MODULATING ANODE REGION OF HIGH-POWER MICROWAVE TUBES
G. Wurthmann, P. Richmond, P. Fischer, and F. Sherburne Feb. 1966 94 p refs
(ECOM-2656; AD-630250) CFSTI: HC $9.60/MF $0.75

An experimental and analytical program has been underway to study the relationship betweeen various geometrical electrode configurations, spacings, materials, and surface finishes as functions of voltage in the electron gun region of high power, modulating anode types of linear beam microwave tubes. The necessary experimental processing equipment and the high voltage test facility needed for checking experimental structures have been designed, constructed, tested, and evaluated. The equipment component design features are discussed in detail. Design and construction features of the first experimental test vehicle are reviewed in depth. This test vehicle has been fully evaluated and the results agree with predicted Fowler–Nordheim current-voltage relationships. Appropriate computer and trajectory plotter programs have been set up for determining equipotential plots and for analyzing beam behavior. The plotter and computer equipment is reviewed, the programming features are outlined, and the applicable techniques for the theoretical design and analysis of electrode configurations and beam behavior are discussed.
Author (TAB)

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N66-23924# Illinois Univ., Urbana. Dept. of Computer Science.
AN APPLICATION OF INTERCOUPLED-TRANSMISSION-LINE-AMPLIFIER
Chushin Afuso 1 Nov. 1965 23 p ref
(Contract Nonr-1834(15))
(Rept.-193; AD-628670) CFSTI: HC $1.00/MF $0.50

An attempt has been made to use an intercoupled transmission line with tunnel diodes as a pulse amplifier for driving, in particular, high-speed diode logic circuits. For this purpose hot-electron diodes were used. The voltage swing of the amplifier is limited by the characteristics of tunnel diodes. It is not large enough to drive hot-electron diodes without bias. Hence it is necessary to bias the diodes properly. A satisfactory result was obtained for the case where overall

voltage gain, including voltage attenuation due to internal resistance of hot-electron diodes, was less than unity. Further trials to obtain a higher voltage gain have been done. The results were not satisfactory, however. Author (TAB)

N66-24111*# Southern Methodist Univ., Dallas, Tex.
SYNTHESIS OF ACTIVE DISTRIBUTED RC NETWORKS
Y. Fu and J. S. Fu Mar. 1966 31 p refs
(Grant NGR-44-007-006)
(NASA-CR-71800) CFSTI: HC $2.00/MF $0.50 CSCL 09C

This work presents a general method for the synthesis of any open-circuit transfer function, which is expressed as a rational function with real coefficients. It is shown that such functions can be realized by using two distributed RC elements (modified by active units if necessary), one negative impedance converter and one lumped capacitor. The distributed RC element used here is a three-layer-structure, a pure dielectric sandwiched in between a perfect conductor and a resistive film. Author

N66-24148# Joint Publications Research Service, Washington, D. C.
SOME PROBLEMS IN THE THEORY OF RELIABLE NEURON NETWORKS
I. B. Gutchin and A. S. Kuzichev *In its* Bionics 20 Apr. 1966 p 174–184 refs (See N66-24126 13-04) CFSTI: $9.10

Three main problems are considered to be inherent in the theory of reliable neuron networks. These involve the construction of algorithms for the design and optimization of formal networks by digital computer, the development of algorithms for the construction of these networks according to given logical functions, and technical simulation of the neurons and reliable neuron networks. Functioning of the neurons may be described by Venn diagrams, and four usable procedures are presented. Consideration is given to the construction of neurons which contain a minimum number of fibers according to the given threshold Venn diagram, and the minimization of such a synthesized neuron is illustrated in tabular form. The logically-stable neuron network is discussed and illustrated. M.W.R.

N66-24149# Joint Publications Research Service, Washington, D. C.
ON THE CONSTRUCTION OF RELIABLE NETWORKS FROM NEUTRON-LIKE ELEMENTS
V. G. Totsenko and B. M. Yegorov *In its* Bionics 20 Apr. 1966 p 185–196 (See N66-24126 13-04) CFSTI: $9.10

An investigation is made of neuron-like elements (NE), such as logical elements having *n* inputs and one output each and realizing certain switching functions. The operation of this NE, usually called the threshold element in computer terminology, is determined by a system of inequalities. Construction of an overflow network of the *mth* order led to the solution of a number of problems relating to switching function (SF), order of the network, and the algorithm for synthesis of the network. The last is actually formulated and presented in diagrammatic form. The method of determining the required order of a network with respect to SF is found, along with the required stability for simultaneous variation of the parameters. The described method is considered applicable for networks realizing the SF with and without one NE. M.W.R.

N66-24150# Joint Publications Research Service, Washington, D. C.
MODEL OF AN INTERMEDIATE NEURON
E. K. Kazimirov *In its* Bionics 20 Apr. 1966 p 197–203 (See N66-24126 13-04) CFSTI: $9.10

A model is proposed for an intermediate neuron which displays the following properties: (1) output of yes–no type, (2) rhythmic activity, (3) five equivalent inputs and two outputs of different polarity, (4) timely summation, (5) threshold of excitation with idle time and relative phases, and (6) signal conducted in one direction with a delay. The model has no truly separated threshold device, the pulse generator is a slave multivibrator made up of two transistors, and the multivibrator permits both an absolute and relative refractory period. The summator signal is not destroyed after triggering the generator, and thereby rhythmic activity is possible. In receptor neurons, because the summator signal is immediately destroyed, rhythmic activity is impossible. However, the proposed model can be adapted for a receptor neuron, with all the properties except rhythm. M.W.R.

N66-24151# Joint Publications Research Service, Washington, D. C.
PROPERTIES OF NEURON MODELS MADE OF TRANSISTORS
E. K. Kazimirov *In its* Bionics 20 Apr. 1966 p 204–209 (See N66-24126 13-04) CFSTI: $9.10

Simulation of living neurons by models made of transistors are considered in a general review of the requirement for such neuron models. Discussed are the essentials for every neuron model: (1) a generator of pulses of constant length and amplitude, (2) a threshold device, (3) a summator of stimulating signals, (4) the passage of signals in one direction with a definite speed, and (5) output of the yes–no type. While there are at present no neuron models which display all these properties to a degree that is considered optimal, there are numerous models for receptor, intermediate, and motor neurons which have been made of transistors. Additional information is required about the actual workings of the living neurons before optimal models can be constructed. M.W.R.

N66-24285# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati.
THE RADIO FREQUENCY SYSTEM OF THE MICROTRON [IL SISTEMA DI RADIO FREQUENZA DEL MICROTRONE]
U. Bizzarri and A. Vignati 28 Dec. 1965 12 p refs In ITALIAN *Its* Nota Interna No. 301
(LNF-65/50) CFSTI: HC $1.00/MF $0.50

A model of a microtron having a maximum energy of 4.5 MeV and an impulse current intensity of 0.5 mA was constructed. Until now, injection has been by means of cold extraction of electrons from the cavity walls. This model permitted a close study of technical problems encountered in the apparatus. Specifically, it was seen that smooth functioning depends to a great extent on the radio frequency system. Technical problems encountered and resolved in the measurement from the radio frequency system and the resonance cavity are described in this report. To assist the reader, definitions of magnitudes and formulas are given. Transl. by R. Li.

N66-24288# Joint Publications Research Service, Washington, D. C.
SOLUTION OF THE PROBLEM OF COMPLETENESS FOR SYSTEMS OF FUNCTIONS OF THE ALGEBRA OF LOGIC WITH UNRELIABLE REALIZATION
S. G. Gindikin and A. A. Muchnik *In its* Probl. in Cybernetics 7 Mar. 1966 p 104–132 refs (See N66-24288 13-08) CFSTI: $7.08

Determinant systems are considered of functional elements, the combination of which does not change in the operating process. It is assumed that the operations of superposition and identification of inputs take place without error, and that the errors in the different elements of the system are independent. D.T.

N66-24289# Joint Publications Research Service, Washington, D. C.

ON THE PROBLEM OF REALIZATION OF SYMMETRICAL FUNCTIONS OF THE ALGEBRA OF LOGIC BY CONTACT CIRCUITS

O. B. Lupanov *In its* Probl. in Cybernetics 7 Mar. 1966 p 132–155 refs (See N66-24286 13-08) CFSTI: $7.08

The results of C. E. Shannon's paper, "A Symbolic Analysis of Relay and Switching Circuits," on the complexity of realizations of symmetrical functions are summarized. In this paper, based on an expansion of a symmetrical function with respect to the elementary periodic functions, the methods of synthesis of contact systems are obtained for functions which permit, with a sufficiently large number of variables, a simple construction. From the results, it follows that known contact systems for the elementary symmetrical functions are not minimal. D.T.

N66-24290# Joint Publications Research Service, Washington, D. C.

TRANSFORMATIONS OF FINITE AUTOMATA

V. L. Murskiy *In its* Probl. in Cybernetics 7 Mar. 1966 p 156–180 refs (See N66-24286 13-08) CFSTI: $7.08

Equivalent transformations were investigated of logical networks, i.e., systems made up of delay and truce elements and sets of zeros and ones which correlate to each series supplied at the input vertices of the systems, a series of values appearing at the outputs. It was found that replacement of a subsystem by its equivalent converts the entire logical network into the equivalent network. Therefore, it is possible to consider that a pair of equivalent systems S and T determine a rule which permits replacement of subnetwork S by T in any network. It was also shown that a finite complete system of such rules does not exist. Equivalent transformations were also investigated of state diagrams. The transformation rule for the diagrams is given by the pair of (A, B) systems S and T, under the conditions that any two diagrams obtained one from the other by replacement of S by T are equivalent. In addition, systems of rules are introduced which are a means of describing families of rules by substitution of specific (A, B) systems in place of variable elements, and it is shown that a finite complete set of such rules does not exist. D.T.

N66-24291# Joint Publications Research Service, Washington, D. C.

ON MINIMAL REALIZATION OF CERTAIN FUNCTIONS OF SYSTEMS OF FUNCTIONAL ELEMENTS

Ye. P. Soprunenko *In its* Probl. in Cybernetics 7 Mar. 1966 p 181–206 refs (See N66-24286 13-08) CFSTI: $7.08

The realization of the conjunction $x_1x_2...x_r$ and the disjunction $x_1Vx_2V...Vx_r$ was investigated. Given that L(r) be the minimum number of elements required for the realization of the conjunction, and L'(r) the minimum number of elements required for the realization of the disjunction; it is proved that $L(r)=2(r-1)$ and the $L'(r)=3(r-1)$. The upper value of the number of elements of the system S realizing a conjunction of length r equaling $2(r-1)$ follows from the fact that the conjunction may be realized by a system on the base $\phi=\bar{x}V\bar{y}$. The lower value corresponding to the upper one was obtained through the use of an auxiliary concept of length of the function. It is shown that the length l(f) of a function f realized by the system S of elements to the base ϕ is such that $l(f) \leq [n/2]+1$. In conclusion, it is proven that if the function is realized by a noniterative tree shaped system S of n elements to the base V, &, −; then the length of the function is no less than $[n/2]+1$. D.T.

N66-24441# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Mulheim an der Ruhr (West Germany).

OUTLINE OF A GENERALLY APPLICABLE METHOD FOR ANALYZATION OF AUTOMATIC CONTROL SYSTEMS WITH CONTROLLED RECTIFIERS BY A THEORY OF SAMPLED SYSTEMS [ENTWURF EINER ALLGEMEIN ANWENDBAREN METHODE ZUR BEHANDLUNG VON REGELKREISEN MIT STROMRICHTERSTELLGIEDERN MIT HILFE DER ABTASTTHEORIE]

J. Martin Feb. 1966 30 p refs In GERMAN; ENGLISH Summary

(DVL-515; DLR-FB-66-05) CFSTI: HC $2.00/MF $0.50

Assuming small variations about a certain operating point, an analytical method is proposed which permits analyzation of the behavior of all types of automatic control systems working with controlled rectifiers for the regulating unit. For this purpose, an equivalent sampled system is introduced which has the following characteristics: A sampler which transfers the input signal at the firing points $\alpha_{z0} + \kappa\pi$. A transfer element, described by the transfer function $G_{st}(s)$, is connected in series to the sampler. G_{st} is determined by the output circuit characteristics; the electrical output quantity (current, voltage, power), and by the assumed operating point (stationary firing angle α_{z0}). All rules of the sampled systems theory are applicable to this equivalent system. An example briefly describes the practical procedure.

Author

N66-24444# California Univ., Berkeley. Electronics Research Lab.

THE USE OF MATHEMATICAL PROGRAMMING IN THE IMPLEMENTATION OF BOOLEAN SWITCHING FUNCTIONS

M. A. Breuer 19 Oct. 1965 116 p refs

(Grants NSF GK-569; NSF G-15985)

(ERL-65-27)

The problems associated with the design automation of digital computers are examined, with particular emphasis placed on the use of integer linear programming (ILP) for implementing the Boolean switching functions. The covering problem is defined, various methods of solution are cited, and the ILP formulation is considered in detail. A proper replacement reduction concept is introduced into the linear program analysis, and a synthesis procedure related to this concept is presented, along with theoretical and numerical results. A result for implementing a switching function with a near minimal set of threshold functions is obtained, and a procedure for converting Boolean functions into equivalent linear equations and inequalities is also given. The Boolean minimization problem is considered, and the problem is solved for the case of realistic engineering and manufacturing conditions. Integer programming techniques are applied to the location and connection problems associated with the physical implementation of Boolean functions, with a single solution obtained for the module placement and connection problems. M.G.J.

N66-24466# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

OPTIMUM PARAMETERS OF AN ON-OFF MANUAL ATTITUDE CONTROL SYSTEM

M. A. Iannce Jul. 1964 78 p refs

(SM-45944)

This report presents the results of an experiment which was conducted to determine statistically the optimum rate feedback gain and dead zone level for an on-off manual attitude control system. The experiment consisted of having a pilot repeatedly null out a two degree attitude error. The performance of the system was rated by a set of three criteria functions which are defined and discussed in the report. The results of the experiment are that an optimum range of dead zone is 1.5 deg/sec $\leq \theta_{DZ} \leq$ 3.0 deg/sec and that the rate feedback gain should be greater than 0.3 rad. In addition, several aspects of manual attitude control systems and manual attitude control system simulation are evaluated. A discussion of simulator requirements is presented, involving the topics of a fixed base versus moving base simulator and single-axis versus three-axis simulation. Author

N66-24515# Joint Publications Research Service, Washington, D. C.

AUTOMATIC OPERATIONAL MANAGEMENT OF PROCESSES OF PRODUCTION

A. B. Chelyustkin, ed. 8 Apr. 1966 331 p refs Transl. into ENGLISH of the book "Avtomaticheskoye Operativnoye Upravleyiye Proizvod Stvennymi Protessami" Moscow, 1965 p 1–247

(JPRS-34972; TT-66-31410) CFSTI: $7.00

Articles on automation of the processes of control of production through the application of advances in technical cybernetics and computer techniques are presented. For individual titles see N66-24516–N66-24535.

N66-24516# Joint Publications Research Service, Washington, D. C.

PROBLEMS IN THE CONSTRUCTION OF PRODUCTIVE ENTERPRISE CONTROL SYSTEMS

A. B. Chelyustkin *In its* Autom. Operational Management of Processes of Production 8 Apr. 1966 p 4–18 (See N66-24515 13-10) CFSTI: $7.00

The purpose of a productive enterprise control system is defined as the organization and support of a productive process to assure that planned tasks are accomplished for the output of product with the best technical and economic indicators. The functions which such a control system must perform are delineated. Methods of computer mathematics are discussed which permit formalizing the finding of optimal solutions to satisfy certain predetermined evaluation criteria under limitations imposed by both external and internal factors. The divergence between the real process and its model is assessed, and the need for continuous correction of planning graphs in accordance with the actual course of the process is pointed out. Examples are given, and a schematic diagram of the controlling part of a complex system is presented. Several mathematical models are discussed, and it is pointed out that the algorithm for finding the optimal distribution can often be reduced to algorithms for solving problems of linear and nonlinear programming. M.G.J.

N66-24517# Joint Publications Research Service, Washington, D. C.

LARGE SYSTEMS AND PROBLEMS OF THE THEORY OF AUTOMATIC CONTROL

A. Ya. Lerner *In its* Autom. Operational Management of Processes of Production 8 Apr. 1966 p 19–25 refs (See N66-24515 13-10) CFSTI: $7.00

The scope and variety of problems connected with large system control theory are discussed, and it is pointed out that the structure of the theory and the basic concepts and terminology for such systems control have not been definitely established. The characteristic features are defined, and a list of examples are given, including power engineering systems, electric power stations, substations, transmission lines, and combinations of people and machines involved in industrial manufacturing processes. These are classified as regular systems, whose functional goal is preserved beyond the limits of the time interval of their work; and irregular systems, whose functional goal arises at the beginning and is achieved at the end of the time interval. The steps considered necessary for control of such systems are outlined, and the factors involved in determining the effectiveness criteria are assessed. The inherent limitations, and the man–machine relationship are discussed, along with methods for constructing mathematical models. M.G.J.

N66-24518# Joint Publications Research Service, Washington, D. C.

THE APPLICATION OF METHODS OF AUTOMATIC CONTROL THEORY FOR OPERATIONAL PRODUCTION CONTROL

N. P. Sevast'yanov *In its* Autom. Operational Management of Processes of Production 8 Apr. 1966 p 26–45 refs (See N66-24515 13-10) CFSTI: $7.00

As undetermined disturbances under real conditions can introduce deviations in the technical and economic indicators from the optimal values, a general algorithm of operation control is formulated. In the method used to obtain the algorithm, the undetermined disturbances are reduced to a single generalized disturbance and the controlled flows to a generalized controlled action, additively connected with the controlled functional. Functional equations of the control objects are constructed and applied to solving reducible problems of operational control and of stepwise planning under conditions of disturbances. Two examples are given. The method of analogies is also described for constructing a model of a complex object in which each deviation of the constructed model from the real process can be related to an equivalent disturbance. An example is included to show the modeling of certain production operations and the construction of production circuits. Simple laws of control which can be used in practice are surveyed, and a qualitative analysis of the entire control process is included. M.G.J.

N66-24519# Joint Publications Research Service, Washington, D. C.

CERTAIN PROBLEMS IN THE MATHEMATICAL DESCRIPTION OF INTERCONNECTED PRODUCTION PROCESSES

N. S. Raybman *In its* Autom. Operational Management of Processes of Production 8 Apr. 1966 p 46–72 refs (See N66-24515 13-10) CFSTI: $7.00

Methods of determining the dynamic characteristics of mathematical models are discussed, for a unidimensional process, and for a productive object with unidimensional processes. Schematics of both processes are included, the numerical characteristics of each are examined, and equations are derived. The dispersion function of a random function, and the reciprocal dispersion function of two random functions are considered, and it is pointed out that the characteristics of these functions should be used in determining the degree

of connection between the variables, independently of the form of connection between them. Linear and nonlinear cases are examined. Based on a comparison of the estimated values of the correlation and dispersion functions, it was concluded that the degree of nonlinearity can be determined on the basis of the F-criterion. M.G.J.

N66-24523# Joint Publications Research Service, Washington, D. C.
CALCULATION OF CERTAIN PARAMETERS OF A SYSTEM OF DISCRETE DIGITAL CONTROL OF A FIELD
E. L. Itskovich *In its* Autom. Operational Management of Processes of Production 8 Apr. 1966 p 109–119 refs (See N66-24515 13-10) CFSTI: $7.00

A solution is proposed to the problem of selecting system parameters for discrete digital control of a homogeneous field distributed along the length of a complex unit. Selection criteria are based on the assurance of the prescribed accuracy of the controlled value measurements for reducing the manufacturing and operating costs of the planned system. In the first stage of the solution, the relation between the discrete errors are determined with respect to time, the spatial coordinate, and the level and the sought parameters of the system. For random functions, statistical interpolation and extrapolation approximations are used. Tabulated data show the dependence of the approximation error on the number of terms of the interpolation and extrapolation polynomials. In the second stage, the interrelation between the given relative error of measurement and all its components is examined. Formulas are derived, and it is shown that in the majority of cases the problem can be solved approximately by the method of sorting the sought values that are possible under real conditions. M.G.J.

N66-24526# Joint Publications Research Service, Washington, D. C.
INVESTIGATION OF AN OBJECT OF CONTROL BY THE METHOD OF STATISTICAL MODELLING
A. A. Belostotskiy *In its* Autom. Operational Management of Processes of Production 8 Apr. 1966 p 149–163 refs (See N66-24515 13-10) CFSTI: $7.00

Details are given on a modeling algorithm constructed to check methods of selecting control parameters. The investigation centered on a discretely noncontinuous section for delivering metal from the open hearth shop to the blooming mill of a metallurgical combine. To obtain qualitative characteristics of the operations performed, estimates of their interconnection in the work, a functional description of the system, and methods of operations research and of mass servicing theories were used. Figures are included to depict the open-hearth furnace blooming mill as a mass servicing system, and block diagrams of the algorithm are included. As a result of the modeling, data on the idle time of the blooming shop, and on the average setting temperature of the metal were obtained. M.G.J.

N66-24529# Joint Publications Research Service, Washington, D. C.
SOME QUESTIONS IN THE ALGORITHMIZATION OF CONTROL PROCESSES
M. I. Obuvalin, V. I. Kot, V. S. Khayet, and P. V. Dokshin *In its* Autom. Operational Management of Processes of Production 8 Apr. 1966 p 227–240 (See N66-24515 13-10) CFSTI: $7.00

Details are given on the development of algorithms for the control of chemical and metallurgical processes. These include dispatcher supervision and operational recording of the work of a production facility; an analysis of disturbances in the industrial process; the use of a universal computer as a correcting regulator; the application of a digital computer for the starting and stopping of complex industrial aggregates; and the use of a digital computer as a central regulator. Several examples are described, with emphasis placed on the realization of the algorithms by means of control computers. M.G.J.

N66-24533# Joint Publications Research Service, Washington, D. C.
CLASSIFICATION OF THE CONDITIONS OF THE FUNCTIONING OF COMPLETELY AUTOMATED COMPLEX PRODUCTION OBJECTS
A. G. Adoyan *In its* Autom. Operational Management of Processes of Production 8 Apr. 1966 p 281–294 refs (See N66-24515 13-10) CFSTI: $7.00

Three special features of complex productive objects of operational control were examined: the large number of states; the instability of its internal structure; and the presence of rigid connections with the external environment and with a series of other complex objects. Concepts of functioning conditions are defined. Selection criteria for classification characteristics are discussed, in which the corresponding regions of values of seven different groups of parameters unequivocally determine the possibilities of the object fulfilling previously assigned functions at a given moment. The main characteristics of three classes—normal, abnormal, and transitional—and of 19 subclasses of the functioning conditions are also listed. M.G.J.

N66-24534# Joint Publications Research Service, Washington, D. C.
THE PRINCIPAL ELEMENTS OF THE METHODS OF DEVELOPMENT OF AUTOMATIC CONTROL SYSTEMS FOR CONTINUOUS MANUFACTURING PROCESSES OF THE CHEMICAL INDUSTRY
V. K. Morozov *In its* Autom. Operational Management of Processes of Production 8 Apr. 1966 p 295–300 (See N66-24515 13-10) CFSTI: $7.00

The steps involved in a functional criteria analysis of a continuous manufacturing process are discussed. The tasks of the process to be automated are defined, in terms of technical and economic indicators, manufacturing parameters, and the selection of a manufacturing installation for creating an experimental automatic control system. The preliminary scientific research and experimental design work is outlined, and the development of several mathematical models is discussed, along with the mathematical formulation of technical and economic optimization tasks. The steps involved in planning such a control system are also listed. M.G.J.

N66-24591*# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
INVESTIGATION OF OPTIMIZATION OF ATTITUDE CONTROL SYSTEMS Quarterly Progress Report, 1 Jun.–31 Mar. 1966
J. Y. S. Luh [1966] 43 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950670)
(NASA-CR-74627) CFSTI: HC $2.00/MF $0.50 CSCL 09C

Progress on several optimal control applications research problems is discussed. In a preliminary study of the optimal control of a particular space vehicle, a closed-loop controller

was synthesized for the system in which the gyro inertia can be ignored and the vehicle displacement is not specified. The harmonic oscillator investigation has given an insight into the form of the extremal control function for a system having a pair of purely imaginary characteristic roots. It is pointed out that the control variable is found to enter and exit from its bound as often as the time duration permits, which is a natural result of the system oscillatory behavior. The antenna pointing problem was reformulated so that the pointing direction was kept within an accepted region with maximum probability all the time. A.O.

N66-24665# Yale Univ. New Haven, Conn. Dept. of Engineering and Applied Science.

ON THE STABILITY OF DYNAMICAL SYSTEMS WITH M-FEEDBACK NONLINEARITIES. PART I: CONTINUOUS SYSTEMS

Kumpati S. Narendra and Charles P. Neuman 15 Nov. 1965 42 p refs

(CT-1)

The new Liapunov function introduced recently is applied to derive sufficient conditions for the absolute stability of continous time dynamical systems with m-monotone increasing, odd monotone increasing, and mixed feedback nonlinearities. These frequency domain stability criteria provide a direct, systematic method for the generation of explicit Liapunov functions. Also, the concept of a common Liapunov function is used to show that if the matrix is positive real, then the dynamical system is absolutely stable for all nonlinear time-varying feedback m-vectors lying in the open sector for all time. Numerous examples are presented in order to illustrate the application of the theoretical results. Author

N66-24879# Industrial Science and Technology Agency, Tokyo (Japan). Electrotechnical Lab.

SYNTHETIC TESTING METHOD AND TESTING CIRCUIT FOR SHORT LINE FAULTS OF CIRCUIT BREAKERS

Itaru Todoriki [1964] 181 p refs In JAPANESE; ENGLISH summary *Its* Res. of the Electrotech. Lab., No. 651

CFSTI: HC $5.00/MF $1.25

This report examines the advantages and disadvantages of a synthetic testing method and a testing circuit for determining short line faults of circuit breakers. The series type of artificial line is proposed for application to the testing circuit for short line faults. The results of theoretical and experimental studies on the characteristics of this artificial line and on the rupturing phenomena of short line fault are described. The artificial line is shown to be better than the real line in economy and operation and can more accurately simulate the characteristics of the short circuited real line in a far less number of elements than the conventional multi-stage ladder circuits. Results of an experimental study on post arc currents of an air blast circuit breaker are described. Details of the apparatus used to measure the post arc currents are described and the fundamental characteristics of the apparatus are discussed. R.N.A.

N66-24934*# Honeywell, Inc., St. Paul, Minn.

BOUNDED PHASE COORDINATE CONTROL Final Report, 15 Jun. 1964–14 Jun. 1965

J. Y. S. Luh, ed. Washington, NASA, May 1966 124 p refs (Contract NASw-986)

(NASA-CR-470) CFSTI: HC $4.00/MF $1.00 CSCL 09C

Two methods based on different concepts are presented for solving bounded phase-coordinate time-optimal control problems. One method originates from Pontryagin's maximum principle and jump conditions in the modified adjoint solution. The computational scheme for this method is derived from sufficiency conditions. The other method is based on the introduction of a measure of excursion of phase-trajectories outside their restraint sets and gives an approximate solution. The computational procedure for this method is developed from the necessary and sufficient conditions which are relatively easy to apply. The method is extended to the solution of optimal problems with integral cost. An on-line analog computer program is developed which proves satisfactory for time-optimal problems with no phase-coordinate bounds, but not directly applicable for problems with bounds. The cause of the difficulty is revealed by an analysis. Areas for further investigation on the bounded phase-coordinate optimal control problems are also outlined. Author

N66-24971*# Westinghouse Electric Corp., Baltimore, Md. Surface Div.

RESEARCH ON FAILURE FREE SYSTEMS Quarterly Report No. 7, Dec. 23, 1965–Mar. 23, 1966

[1966] 11 p ref

(Contract NASw-572)

(NASA-CR-74686; WGD-38521) CFSTI: HC $1.00/MF $0.50 CSCL 09C

A summary is presented of theoretical considerations in the development of computerized procedures for allocating a limited number of test points within a redundant system and for estimating the system reliability when one or more components have failed at the time of estimation. The minimal cuts reliability analysis procedure to reflect test information was examined, and it was determined that once the system as a whole is known to be working, the expressions describing the probabilities that individual units in a stage are working are no longer statistically independent. However, from further analysis it was determined that if three test points are placed in a stage, then the operational state of a unit is deterministic rather than probabilistic and the unit reliability estimates can again be considered independent, thus allowing the use of the minimal cuts analysis technique. Conceptual difficulties associated with this procedure and the complications of converting the undocumented FAP language portions of the existing computer program indicated that an alternative procedure should be considered. This procedure is discussed briefly. The analysis of placing test points in a single stage triple redundant system is discussed and a typical set of results are shown. H.S.W.

N66-25100# Stanford Univ., Calif. Stanford Linear Accelerator Center.

IMMITTANCES OF REDUCED DEGREE AND NONPOSITIVE REAL IMMITTANCES IN NETWORK SYNTHESIS

John A. C. Bingham Oct. 1965 10 p refs Presented at 3d Ann. Allerton Conf. on Circuit and System Theory, Chicago, 20–22 Oct. 1965

(Contract AT(04-3)-400)

(SLAC-PUB-150; CONF-651047-1) CFSTI: HC $1.00/MF $0.50

In previous work by Darlington (Bell Telephone System Monograph B1186, p. 44) on a symmetrical parametric bandpass filter of degree eighteen, a real network with all positive elements which performed exactly as prescribed was found from two nonpositive real immittances. The theoretical resolution of this paradox is discussed. NSA

N66-25104# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
A MODULAR STRUCTURE OF DIODES AND TRANSISTORS FOR THE TREATMENT OF INFORMATION IN NUCLEAR PHYSICS EXPERIMENTS [UNA STRUTTURA MODULARE A DIODI E TRANSISTORI PER IL TRATTAMENTO DELLE INFORMAZIONI IN ESPERIENZE DI FISICA NUCLEARE]
A. Carlucci and E. de Agostino Jun. 1965 15 p refs In ITALIAN (RT/EL(65)-5)

Design of a modular structure at combinational levels is described. The maximum frequency of operation with a very high fan-in is of the order of some megacycles.

Author (NSA)

N66-25162*# Tennessee Univ., Knoxville.
APPLICATIONS OF RATE DIAGRAMS TO THE ANALYSIS AND DESIGN OF A CLASS OF ON–OFF CONTROL SYSTEMS
Ralph C. Lake Washington, NASA, May 1966 68 p refs (Grant NsG-351)
(NASA-CR-484) CFSTI: HC $3.00/MF $0.75 CSCL 09C

The rate diagram technique is applied to some configurations of on–off control systems to aid in the design and analysis of these systems. It is stated that a previous method used a Laplace transformation of the error signal, thereby constraining the error signal filter to be linear. In this research, the rate diagram idea is formulated by utilizing the state variable representation, thus removing the constraint of the linear filter. A discussion of the rate diagram method is provided, which includes some of the mathematical considerations involved, and the advantages of the rate diagram over phase plane methods are listed. Equations are derived for the rate diagram analysis of two separate systems. Rate diagrams were constructed, and are shown, for the systems considered and the values of the system parameters used for constructing these diagrams are given. Appended are computer programs for determining the transient response of the two on–off control systems considered. H.S.W.

N66-25301# Joint Publications Research Service, Washington, D. C.
SYNTHESIS OF NONLINEAR CONTROL LAWS
R. A. Nelepin 3 May 1966 10 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), no. 6, 1966 p 1312–1314
(JPRS-35311; TT-66-31747) CFSTI: $1.00

In an automatic system (usually a servomechanism) there exist definite nonlinearities and to compensate for their harmful effect and to improve the dynamic properties of the system, it is necessary to introduce special nonlinearities into the control laws. This report considers methods for solving this problem on the basis of exact analytic methods with respect to an automatic system of the nth order. R.N.A.

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N66-23902# Advanced Research Projects Agency, Washington, D. C.
LARGE APERTURE SEISMIC ARRAY. LASA SYSTEM EVALUATION CONFERENCE (1st), SEPTEMBER 11-13, 1965
Feb. 1966 300 p refs
(AD-628901) CFSTI: HC $6.00/MF $1.50

This conference report consists of a compilation of papers describing the LASA installation in Montana. This includes the ground installation, data transmission and data acquisition systems. In addition, the proposed long-period seismometer installation is discussed, as well as potential on-line and off-line processing systems for the Billings Data Center. Preliminary results from the installation are reported along with results from Tonto Forest Seismological Observatory with instruments spaced over similar distances. An extensive series of papers describe the beam pattern analyses for the LASA installation and present theoretical data which will bear on the array geometry if additional arrays are to be constructed. Finally, prototype station requirements are developed, reflecting the current assessment of the desirable station configuration.

Author (TAB

N66-23911# Naval Avionics Facility, Indianapolis, Ind.
THE PERFORMANCE OF SiO (NAFI IF-1008) IN SINGLE-CHAMBER VACUUM SYSTEMS Interim Report, Nov. 1964–Mar. 1965
William C. Underwood 13 Dec. 1965 15 p
(NAFI-TR-678A; AD-628664) CFSTI: HC $1.60/MF $0.50

An evaporation source for deposition of silicon monoxide thin films was reported to possess high raw material capacity and high evaporation rate characteristics. The source design was evaluated in two different laboratory bell jar vacuum systems and was found to be unsatisfactory. Author (TAB

N66-24038# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
INVESTIGATION OF DYNAMIC CHARACTERISTICS OF A 1/20TH SCALE MODEL OF THE LAUNCH PHASE SIMULATOR
Charles J. Arcilesi and Lloyd R. Bruck *In* NRL The Shock and Vibration Bull., No. 35, Pt. 3 Jan. 1966 p 207–225 refs (See N66-24020 13-32) CFSTI: HC $6.00/MF $1.50

Vibratory investigations were conducted on a 1/20-scale dynamically similar model of the launch phase simulator, an advanced combined environmental test facility, to obtain design data and to study potential problem areas. For these purposes, the model was designed by using the replica scaling technique; i.e., all important structural, elastic, and dynamic features of the full-scale facility were duplicated to 1/20-scale. In addition, all external geometric dimensions were scaled to insure aerodynamic similarity, as the model had to be tested in the stationary mode and at scaled rotational speeds, to simulate full-scale loading conditions. The vibration modes, frequencies, transmissibilities, and modal damping characteristics for these conditions are presented and discussed at length. Results indicate that no serious problem areas, such as flutter and oscillating lift, are apparent, but self-excited phenomena caused by drive system characteristics may exist in the full-scale facility. Comparison of the model characteristics with results from theoretical investigations are presented and indicate very close agreement. These experimental data have proved invaluable in the full-scale or prototype system design, in serving as a verification of theoretical analyses, in addition to providing design parameters not readily available through analytical techniques. Author

N66-24238# European Organization for Nuclear Research, Geneva (Switzerland). Accelerator Research Div.
COLLIMATORS FOR THE RF SEPARATED BEAM
R. D. Fortune 23 Feb. 1966 27 p refs
(CERN-66-10)

The collimator design for simple and precise remote control of all components is described, along with the material, drive, alignment, and performance. Included in the design are the remote control and direct digital indication of jaw position to a precision of ±0.1 mm; independent jaw movement allowing eccentric beam setting; monitoring of beam position by means of scintillator counters attached to the jaws; automatic closure (for use of the collimator as a beam blocker by the accelerator control group); and specially designed microswitches of negligible degassing rate for use as limit switches inside the collimator vacuum box. N.E.N.

N66-24325# Aeronautical Research Inst. of Sweden, Stockholm.
[DESCRIPTIVE REPORT OF ACTIVITIES OF THE FLYGTEKNISKA FORSOKSANSTALTEN, FFA]
1965 56 p
CFSTI: HC $3.00/MF $0.50

A narrative account is given of the FFA institute, its facilities, and its activities. The FFA has wind tunnels for static and dynamic testing of airplane models for the whole speed range from low subsonic to hypersonic speeds. In addition, it has equipment for the mechanical testing of complete airplane structures, structural components, and test specimens under static or fatigue loading. Theoretical as well as experimental research is performed, along with the designing and fabrication of models, test equipment, and instruments. D.T.

N66-24387*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL INVESTIGATION OF MEGAWATT DIRECT-CURRENT ARC HEATING OF NITROGEN
J. Perry Campbell and Donald R. Boldman Washington, NASA, May 1966 41 p refs
(NASA-TN-D-3423) CFSTI: HC $2.00/MF $0.50 CSCL 20M

Four arc heater concepts, each able to provide arc power levels in excess of 1 megawatt in nitrogen, were evaluated for their ability to power hypersonic arc tunnels. Performance efficiency of a multiple-chamber magnetically spun arc heater ranged from about 45 percent at a power level of 600 kilowatts to about 30 percent at 1200 kilowatts. The magnetically spun arc heater units provided nominal stagnation pressure and enthalpy of 2 atmospheres and 5500 Btu per pound, respectively, with flow rates from about 0.035 to 0.056 pound per second. A vortex-stabilized arc attained a high gas enthalpy at 1 atm pressure and a flow rate of 0.032 lb/sec. A split-ring and a ring cylinder configuration, operating at gas flows of about 0.4 pound per second under 10 atm pressure, reached gas enthalpies of about 3000 Btu per pound. It was concluded that the performance limitations of the various heater designs may be reduced by using more than one type of heater to obtain the desired enthalpies. G.G.

N66-24410# United Kingdom Atomic Energy Authority, Culham (England).
30 kG, 8-1/2 INCH BORE SUPERCONDUCTING COIL
D. N. Cornish Oct. 1965 13 p ref
(CLM-P90)

A 30 kG, 8-1/2" bore superconducting coil has been designed using the minimum propagating current data obtained on a short length of composite superconductor. Tests on the coil show complete agreement between predicted and actual performance. Author

N66-24428# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
DESCRIPTION OF THE AEROSPACE RESEARCH LABORATORIES AT THE LONG ISLAND GRADUATE CENTER
Apr. 1966 119 p refs

The overall layout of the Graduate Center is presented, with specific details given on the experimental research facilities. These include the electrophysics and gas dynamics laboratories, shock tunnels, rocket propulsion equipment, instrumentation, machine shop, hypersonic and supersonic wind tunnels, and vacuum pumping equipment. The theoretical and experimental studies being conducted are outlined, and cover such research areas as hypersonic configurations under low density conditions, wake measurements, electromagnetic properties of hypersonic flows, precursor effects, rocket propulsion, ultra velocity flows, time dependent flow analyses, advanced facilities development, and subsonic flow problems. Abstracts are also included on technical activities in aerophysics and flow, solid mechanics, and electrophysics. M.G.J.

N66-24434# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.
SOME OPERATIONAL CHARACTERISITCS OF IN-PAVEMENT LIGHTING FIXTURES Interim Report
Cecil B. Phillips Nov. 1965 41 p refs
(RD-65-133)

The purposes of the overall project are: (1) To determine procedures for use by manufacturing, testing, and installing organizations in testing in-pavement lighting fixtures; and (2) to test new light sources. This report discusses some of the characteristics of in-pavement lighting fixtures that have been observed during the conduct of the project. Author

N66-24511*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE MOLECULAR SINK SIMULATOR FACILITY DESIGN
James B. Stephens 15 Mar. 1966 19 p refs
(Contract NAS7-100)
(NASA-CR-74654; JPL-TR-32-901) CFSTI: HC $1.00/MF $0.50 CSCL 14B

This report summarizes the results of research, design, and development efforts for a space molecular sink simulation facility now under construction. The longitudinal-wedge-fin, 21°K hydrogen-refrigerated, molecular-trap array has been shown to provide a capture improvement of an order of magnitude over that of smooth-walls, capturing 99.97% of the condensable molecules of O_2, N_2, A, CO, and CO_2 that emanate from the test item before they can return. An electron-beam titanium sublimator will be used to pump hydrogen and, also, chemically permanently fix the cryo deposits. A 1300-ft^3 min mechanical pump (operated in the viscous-flow regime to eliminate backstreaming) and a 140-l/sec turbo-molecular impact pump will be used to rough pump the double-walled, double-doored 10-ft-diam vacuum chamber and to sustain the guard vacuum. The chamber is decontaminated by glass-bead blasting in conjunction wih a 250°C vacuum bake-out. Conventional extreme-high-vacuum and cryogenic instrumentation and controls will be used; cryogenic quartz-crystal microbalances with a sensitivity of 1×10^{-10} g/cm^2 will be used to measure condensable molecular fluxes; and a cryogenic quadrupole mass spectrometer will be used to monitor the molecular specie emanating from the test item. Author

N66-24575# Aeronautical Research Inst. of Sweden, Stockholm.
THE FFA AERODYNAMIC RESEARCH AND TEST FACILITIES
1964 106 p
(FFA-MEMO-33) CFSTI: HC $4.00/MF $0.75

This report describes the aerodynamic research and test facilities of the Aeronautical Research Institute of Sweden. Included are descriptions of the institute's organization, general layout of the aerodynamic facilities, low speed tunnel, transonic tunnel, vacuum plant and tunnels, air supply for the trisonic and hypersonic tunnels, hypersonic tunnels, hypersonic gun tunnel, instrumentation equipment common to all wind tunnels, data processing and presentation, and workshop. R.N.A.

N66-24632*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ENDLESS-BELT TECHNIQUE FOR GROUND SIMULATION
Thomas R. Turner *In* NASA. Ames Res. Center Conf. on V/STOL and STOL Aircraft 1966 p 435-446 refs (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

The use of an endless-belt ground plane for ground simulation in wind-tunnel tests has been investigated. Results of the investigation presented herein indicate that the endless-belt ground plane correctly simulates the ground but that not all models require this technique of simulation. In general, those configurations in which the lift is carried primarily in discrete jets (tilting ducted and jet V/STOL) do not require the endless belt for ground simulation and those in which the lift is distributed over the span of the wing do require the endless-belt ground plane. However, the need is dependent upon the lift coefficient and height above the ground. Author

N66-24715# Naval Research Lab., Washington, D. C.
THE NRL CYCLOTRON PROGRAM Progress Report, Period ending Sep. 1, 1965
Rollon O. Bondelid, Richard G. Alias, Clarence D. Bond, John A. Eisele, John L. Toth et al 1 Sep. 1965 55 p refs *Its* Cyclotron Rept.-2
(NRL-6366; AD-628928) CFSTI: HC $5.60/MF $0.50

The cyclotron, an improved version of the Oak Ridge Isochronous Cyclotron (ORIC), will furnish large ion currents (up to 1 mA) with variable energy (from 5 to 75 MeV for protons), and a large choice of ion species for research in nuclear physics. The magnet gap of the NRL cyclotron has been changed from the vertical plane used in the ORIC to the horizontal plane because an analysis indicates that there will be a large improvement in the intensity of the energy-analyzed beam. This and other changes based on operating experience at the ORIC were incorporated in the scope of work given to the engineering firm who prepared bid packages, and assisted in the procurement of components, and in the critical path management scheduling of the cyclotron program. An automated system, utilizing a Hall-plate which is positioned by a tape-controlled table, has been developed to map the magnetic field of the cyclotron. Computational techniques have been developed for analysis of various ion-optic problems. Preliminary analysis of the combination of an energy-analyzing magnet, switching magnets, and quadrupoles has been performed so that the beam can be brought into any one of eleven proposed beam paths. Detailed design of three beam paths which will be instrumented initially has been completed. A major feature of the cyclotron beam-transport system is an 80-ton, 135-degree, 9-ft-radius energy-analyzing magnet which has an energy resolution better than 5000. Author (TAB)

N66-24770# RAND Corp., Santa Monica, Calif.
LOGISTIC IMPLICATIONS OF AN ASTRONOMICAL OBSERVATORY ON THE MOON
R. J. Freeman, R. C. Moore, and G. F. Schilling Feb. 1966 42 p refs
(Contract AF 49(638)-1700; Proj. Rand)
(RM-4916-PR; AD-629425) CFSTI: HC $4.60/MF $0.50

A study of one aspect of possible post-Apollo space activity-a program of astronomical research on the moon that culminates in the establishment of a lunar observatory. A mathematical model is used to analyze the logistics implications of conducting such an astronomical research program. The nature of the equipment needed for the accomplishment of the program is outlined. Superposition of this program upon a basic long-term lunar-base operations plan tentatively indicates that it could be conducted during the 1970's and 1980's, well within the constraints imposed by the logistics of presently planned spacecraft, boosters, and launching facilities. Although the best available numbers were used, the present study is viewed more as an exposition of a methodology than as the establishment of a conclusive result. Author (TAB)

N66-24780# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONSTRUCTION OF AIRPORTS
A. A. Gerberg and A. S. Osipov 9 Apr. 1965 412 p refs Transl. into ENGLISH of the book "Stroitel'stvo Aerodromov" Moscow, Nauchno-Tekhn. Izd. Min. Avtomobil'nogo Transporta i Shosseynykh Dorog RSFSR, 1962 331 p
(FTD-TT-64-1273/1+2; AD-615528) CFSTI: HC $7.15/MF $2.00

This book presents the principles of organizing airport construction. It describes preparatory, earth-moving operations and shows the construction of the water drainage network. An extensive description is given of the types of airport pavements and of the methods of constructing them. Recommendations, based on studies of advanced experience of airfield construction organizations, are given about adapting the most effective methods for executing the work with maximum utilization of mechanization facilities. Author

N66-24823# General American Transportation Corp., Niles, Ill. Research Div.
SHELTER PACKAGE VENTILATION KIT Final Report
Basil A. Libovicz and Herman F. Behls Oct. 1965 111 p refs
(Contract OCD-PS-64-22)
(GARD-1244; AD-629633) CFSTI: HC $4.00/MF $0.75

A portable ventilation system that can be driven manually or by an electric motor was developed for use in Civil Defense fallout shelters. This package ventilation kit includes a fan assembly and drive modules which can be assembled and operated by untrained personnel. Author (TAB)

N66-24844# Midwest Research Inst., Kansas City, Mo.
ANALYSIS OF CRITERIA FOR PAVEMENT SLOPES Final Report
Frank Turner May 1965 82 p refs
(Contract FAA-ARDS-569)
(SRDS-RD-65-53)

A study was made of runway design criteria based on the performance of existing aircraft. The operational surfaces of airports were found to be satisfactory for present day aircraft. An analysis of the grade effect on a number of hypothetical runway configurations led to the formulation of methods to

determine a value of effective gradient based on the grade effect during various segments of ground operation. The take-off performance is critical on uphill or cup shaped runways, while accelerate-stop is critical on downhill and humped profiles. A length correction factor calculation is recommended for each aircraft to determine the final runway length. Criteria governing change in grade and distance between vertical curves were analyzed and found satisfactory. No changes are recommended in the minimum line-of-sight on the runway, the maximum grade change, and the transverse slopes. The maximum slope on the apron was increased to equal the grade allowed on taxiways. Author

N66-24967*# Bendix Corp., Ann Arbor, Mich. Systems Div.
SURVEYOR LUNAR ROVING VEHICLE, PHASE I. VOLUME I: PROGRAM SUMMARY Final Technical Report
Apr. 1964 28 p Prepared for JPL
(Contracts NAS7-100; JPL-950656)
(NASA-CR-71257; BSR-903) CFSTI: HC $2.00/MF $0.50 CSCL 13F

A summary is presented of design studies and the engineering test model development program for a roving vehicle payload for the Surveyor lunar soft landing spacecraft. A complete mission analysis was conducted, and the major conclusions from this analysis are discussed. The systems analysis considerations are reviewed and it was concluded that a gross system weight of 125 lbs is desirable. The major trade-offs in the system design involved optimizing power, data rate, and vehicle speed to achieve the shortest mission time. The difference between high gain directional antennas and omni-directional antennas was considered to be the most sensitive of these trade-offs. Further analysis established the directional antenna as a firm requirement for Surveyor lunar roving vehicle (SLRVO) feasibility. Vehicle control and safety were also considered and it was concluded that the ability to control the vehicle would be improved appreciably by the inclusion of a fixed-based stereo imaging sensor on the vehicle. The SLRV reliability analysis program is described and the conclusions which resulted from this analysis are given. Recommendations are also made for additional studies in the SLRV program. H.S.W.

N66-25014*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE SIMULATOR FACILITIES AT THE JET PROPULSION LABORATORY
1 Mar. 1965 30 p refs
(Contract NAS7-100)
(NASA-CR-74849; JPL-TM-33-197) CFSTI: HC $2.00/MF $0.50 CSCL 14B

This report describes the space simulator facilities presently available. The description includes temperature, pressure, and irradiation capabilities, test instrumentation available, and data handling capabilities. Author

N66-25037# California Univ., Berkeley. Inst. of Engineering Research.
FRICTION IN ULTRAHIGH VACUUM
J. Frisch, R. D. Nelson, and P. Pfaelzer Sep. 1965 69 p refs
(Contract W-7405-ENG-48)
(UCRL-13190; MD-65-8) CFSTI: HC $3.00/MF $0.75

The design and construction of equipment for the investigation of friction behavior of single crystal surfaces in vacuum at 10^{-9} torr is described. A special hydraulic system provides the motion for the specimens, which are cleaned by sputtering in the vacuum chamber. Techniques for growing Al single crystals are given. An appendix contains a brief review on the theories of dry friction. NSA

N66-25160*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPLORATORY STUDY OF PERFORMANCE OF THE LANGLEY PILOT MODEL EXPANSION TUBE WITH A HYDROGEN DRIVER
Jim J. Jones and John A. Moore Washington, NASA, May 1966 55 p refs
(NASA-TN-D-3421) CFSTI: HC $2.00/MF $0.50 CSCL 14B

An exploratory investigation has been made of expansion-tube flows using an unheated hydrogen drivar, and the performance is compared with previous theoretical calculations. Studies of the velocity of the several fronts, the static pressure, and the test-section pitot pressure were made and discrepancies from the elementary theory noted. These discrepancies were analyzed in terms of viscous and nonideal flow effects. The general conclusion of the investigation is that these effects do not seriously impair the usefulness of the facility as a tool in high-velocity flow research. Author

N66-25171# Technische Hochschule Munchen (West Germany).
THE PRINCIPLES OF AIR-CLASSIFYING BY COUNTER-CURRENT DEFLECTION [DIE GRUNDLAGEN DER GEGENSTROMUMLENKSICHTUNG]
Klaus Müller Düsseldorf, Vereins Deutscher Ingenieure, 1966 43 p refs In GERMAN; ENGLISH summary *Its* Res., Vol. 32, No. 513

The counter-current air classifier is a very simple apparatus, without moving parts, used for classifying fine particulate material at a cut-size of 1000 down to 50 micrometers. The classification results from the different trajectories which are followed by particles of different sizes when injected into an air-stream. The trajectories of single particles in the classifier were theoretically determined under simplified conditions with the help of an analog computer, and then compared with the actual results of the experiment. The classification under condition of hindered movement in the dust-laden air cannot be described in this way. From the equations of the particle-trajectories a set of dimensionless groups has been derived. The original classifier can be improved by giving it a special shape. The results as obtained with this new type of classifier have been correlated in the form of a product of powers of the dimensionless groups mentioned before. Author

N66-25188# Republic Aviation Corp., Farmingdale, N. Y.
LONGSHOT I HYPERSONIC FREE-PISTON TUNNEL
Dec. 1963 56 p refs
(RAC-1884; RD-TR-63-43)

This report presents a complete description of the Longshot I free-piston cycle hypersonic tunnel. Mechanical aspects as well as the free-piston cycle process are discussed. Instrumentation used and data acquisition and processing techniques are also described. Examples of actual data obtained in Longshot I are included. Author

N66-25191# Environmental Science Services Administration, Atlantic City, N. J. Test and Evaluation Lab.
AN ANALYSIS OF MODIFICATIONS TO RUNWAY VISUAL RANGE EQUIPMENT FOR LOW RVR VALUES Final Report

Matthew Lefkowitz and Ernest E. Schlatter Feb. 1966 84 p refs
(RD-66-9)

Several transmissometer configurations using 250-foot baselines have been compared to develop a system with capability of measuring very low values of runway visual range. The existing "standard" 500-foot baseline system was used as the comparison reference. The end-to-end dual system was considered most representative of the present standard. A single transmissometer system was judged to be less representative, primarily due to sampling differences. Author

N66-25334# Oak Ridge Inst. of Nuclear Studies, Inc., Tenn.
THE DESIGN OF A LOW-BACKGROUND WHOLE-BODY COUNTING FACILITY
A. C. Morris, Jr. and D. A. Ross (Oak Ridge Natl. Lab.) Washington, AEC, Jan. 1966 53 p refs
(Contract AT(40-1)-GEN-33)
(ORINS-S1) CFSTI: HC $3.00/MF $0.50

The whole-body counter is described, and the selection of materials for use in the facility is discussed in detail. The construction of the facility is also outlined. NSA

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N66-23890# David Taylor Model Basin, Washington, D. C.
CAVITATION TESTS OF A TRACTOR PROPELLER ARRANGEMENT FOR THE PC(H)
James G. Peck Jan. 1966 41 p refs
(DTMB-2154; AD-628854) CFSTI: HC $4.60/MF $0.50

Three tractor propellers, designed for PC(H), were tested on the PC(H) model configuration in the TMB 36-inch variable pressure water tunnel. Cavitation characteristics, thrust deduction curves, and sketches of the cavitation of each propeller were obtained. Of the three propellers tested, only one was more efficient than a previously tested tandem propeller arrangement. Author (TAB)

N66-23901# Naval Oceanographic Office, Washington, D. C.
THE CALCULATIONS OF THE ANOMALIES OF V FOR THREE-DIMENSIONAL BODIES BY A "PALETTE" OF A TWO-DIMENSIONAL BODY [OBCHISLENNYA ANOMALIY V, NAD TRIVIMIRNIMI TILAMI PALETKOYU DVOVIMIRNOHO TILA]
Ya. A. Yunkov 1965 5 p Transl. into ENGLISH from Dopovidi Akad. Nauk Uk. RSR (Kiev), no. 10, 1960 p 1393–1395 (Trans-282; TT-66-60600; AD-628416) CFSTI: HC $1.00/MF $0.50

A method for calculating easily the anomalies in gravitational potential of three-dimensional bodies, requiring only one palette, is presented. A cylindrical mass of arbitrary cross section and parallel to the y-axis in an x-y plane is considered. Equations are also given in terms of polar coordinates. An expression is derived for the sum of infinitely thin cylinders. The conditions which permit calculation of the anomalies are discussed. N.E.N.

N66-23906# Naval Oceanographic Office, Washington, D. C.
THE CALCULATION OF ANOMALIES V_{zz} OF THREE-DIMENSIONAL BODIES WITH A PALETTE OF A TWO-DIMENSIONAL BODY [OBCHISLENNYA ANOMALIY V_{zz} NAD TRIMIRNIMI TILAMI PALETKOYU DVOMIRNOGO TILA]
Ya. A. Yun'kov 1965 5 p Transl. into ENGLISH from Dopovidi Akad. Nauk Uk. RSR (Kiev), no. 10, 1960, p 1224–1226 (TRANS-283; TT-66-60601; AD-628417) CFSTI: HC $1.00/MF $0.50

Consideration is given to the calculation of V_{zz} anomalies of three-dimensional bodies with a palette of a two-dimensional body. Relative to this, a method is described which requires only one palette that permits the interpretation of anomalies of three-dimensional bodies of free form. C.T.C.

N66-23912# RAND Corp., Santa Monica, Calif.
CONVECTIVE INSTABILITIES IN FULLY DEVELOPED FLOWS
M. Sherman Feb. 1966 13 p refs
(P-3308; AD-628098) CFSTI: HC $1.60/MF $0.50

This paper considers the possibility of inducing a convective secondary flow in the fully developed channel flow of a quasi-incompressible (Boussinesq) fluid. Instabilities of this type can only occur when the temperature gradient in the direction of the body force exceeds a certain critical value. This temperature gradient is proportional to the Rayleigh number of the fluid. For channels of arbitrary cross section the critical Rayleigh number is found to be $R_c \geq 1360\ (h/d)^4$ where h is the arbitrary channel's maximum dimension in the body force direction and d is the diameter of an equal area circular channel. For two special geometries it is possible to improve the above lower bound estimate to the critical Rayleigh number. In a circular channel $R_c \geq 3450$ and in a square channel $R_c \geq 2480$. Author (TAB)

N66-23916# David Taylor Model Basin, Washington, D. C. Hydromechanics Lab.
THE FORCE AND MOMENT ON A SLENDER BODY OF REVOLUTION MOVING NEAR A WALL
J. Nicholas Newman Dec. 1965 16 p refs
(DTMB-2127; AD-628161) CFSTI: HC $1.60/MF $0.50

Analytical results are derived for the vertical force and pitch moment acting on a body of revolution which is moving with constant forward velocity parallel to an infinite horizontal wall. It is assumed that the fluid is ideal and incompressible and that the body is slender and situated close to the wall. The force and moment are given in terms of simple integrals involving the body shape and separation distance from the wall. Calculations are made for a spheroid, and it is shown that the vertical force rises rapidly as the body is brought progressively closer to the wall. Author (TAB)

N66-23935# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
THEORY OF COAGULATION AND PRECIPITATION OF PARTICLES OF AEROSOL IN TURBULENT FLOW OF GAS. ON THE COEFFICIENT OF CAPTURE OF AEROSOL PARTICLES [TEORIYA KOAGULYATSII I OSAZHDENIYA CHASTITS AEROZOLYA V TURBULENTNOM POTOKE GAZA. O KOEFFITSIENTE ULAVLIVANIYA CHASTITS AEROZOLYA]

V. G. Levich Dec. 1965 12 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 99, 1954 p 1041–1044
(Contract AF 19(628)-5034)
(GTR-65-11; AD-629045) CFSTI: HC $1.00/MF $0.50

In turbulent flow, precipitation of particles does not take place if the velocity of their fall in the field of gravity is small compared to the characteristic velocity of the turbulent disturbance (this always takes place for aerosol). An exception may be the region at a very small distance from the horizontal fixed surface, where turbulent motion of the fluid is hindered. TAB

N66-23936# Politecnico di Torino (Italy). Istituto di Meccanica Applicata.
THEORETICAL INVESTIGATIONS ON THE BOUNDARY LAYER WITH PRESSURE GRADIENT Scientific Report No. 8
Ennio Mattioli Aug. 1965 24 p refs *Its* Tech. Note 32
(Grant AF-EOAR-98-63)
(AFOSR-65-2736; AD-629212) CFSTI: HC $2.60/MF $0.50

Some recent investigations about the boundary layer, with pressure gradient, in the incompressible fluid flow along a flat, smooth plate, are briefly summarized. The results of those investigations are compared with the experimental ones found by the author. Some considerations are drawn on the Tollmien–Schlichting theory of instability, the transition Reynolds number, the origin of the spots and the outline of the turbulent boundary layer. Author (TAB)

N66-23957# Oklahoma State Univ. Research Foundation, Stillwater. Acoustics Lab.
SHEAR WAVE PROPAGATION IN BIREFRINGENT VISCOELASTIC LIQUIDS OF LOW RIGIDITY AND LOW VISCOSITY
George B. Thurston Mar. 1966 34 p refs Presented at the Rheology Conf., Pinebrook, N. Y., 23–27 Aug. 1965
(Contract Nonr-2595(03))
(AD-629179) CFSTI: HC $2.00/MF $0.50

Utilizing the optical birefringence induced by shearing deformation of viscoelastic liquids it is possible to carry out direct quantitative measurements of the progression of a shear wave in the liquid. From measurements of the amplitude and phase of the optical effect versus propagation distance, values of the attenuation and phase constants of the medium are obtained. From these, a complex coefficient of viscosity is determined. An improved optical detection scheme permits measurements as near to the shear wave source as 100 microns with a field resolution of approximately 10 microns. It is thus possible to carry out measurements for liquids of viscosity near that of water and having very low rigidity. A theoretical model for a dilute suspension of rigid macromolecules of ellipsoidal shape is described and measured values are compared with the theory. This is done for an aqueous suspension of colloidal alumina, Dupont 'Baymal', with good general agreement as to frequency and temperature dependence of the propagation characteristics. Measured values are also presented for a polyethylene oxide polymer in combination with Baymal in water. Author (TAB)

N66-23970# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINING THE DENSITY OF A GAS BEHIND A SHOCK WAVE FROM SHADOW PHOTOGRAPHY
A. N. Semenov 20 Jan. 1966 138 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 4, no. 4, 1964 p 743–750
(FTD-TT-65-1386/1+2+4; AD-629471) CFSTI: HC $2.60/MF $0.50

The method of determining density from shadow photographs and the limitations of the method were examined. The Fresnel diffraction on the boundary of the geometric shadow and the diffraction distribution were calculated. A theoretical determination was made for the ratio of densities at the summit of a nonstationary axisymmetric shock wave, formed during the interaction of the flat front of the wave and a sphere. Equations were derived for divergent, convergent, and parallel pencils of light. The width of the shadow bands and the illumination distribution obtained on a photograph were measured, and the distribution curve calculated using the Fresnel diffraction equations. Graphs of the curves are included, and the systematic errors were evaluated. It was concluded that the value of the density behind the shock wave could be easily found using shadow photography. N.E.N.

N66-23989# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE FLOW OF A LIQUID IN THIN LAYERS
P. A. Semenov and A. V. Solov'yev *In its* J. of Eng. Phys. 3 Jan. 1966 p 24–30 refs (See N66-23986 13-33) CFSTI: HC $3.00/MF $0.50

Examined was the flow of a thin layer of viscous fluid along a vertical wall whose free surface was subjected to friction from a rapidly moving gas. Equations were formed to express the direct relationship between the pressure gradient and the thickness of the liquid layer, and wave motions were introduced as results of super positions of periodic deviations in velocities and pressures on the steady-state flow. Derived formulas were valid for certain flow rates in the gas and liquid phases, corresponding to a regime of rising flow near the point of flooding as characterized by transition from forward flow to counter flow. G.G.

N66-23991# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINATION OF LINEARIZED PERTURBATION FLOWS IN THE CASE OF AN AIRSTREAM FLOWING PAST NONAXISYMMETRIC CONIC BODIES AT GREAT SUPERSONIC VELOCITY
A. M. Mkhitaryan and M. P. Ovsyannikov *In its* J. of Eng. Phys. 3 Jan. 1966 p 33–53 refs (See N66-23986 13-33) CFSTI: HC $3.00/MF $0.50

A method was derived to solve the problem of streamlining nonaxisymmetric conic bodies with an inviscid supersonic stream of gas which does not conduct heat, by superpositioning the linearized solution on the nonlinear solution for a round cone. Velocity equations for the linearized perturbation flow were formed, and formulas expressing thickwalled conic bodies streamlined by an ideal gas and also for a thinwalled conic body, were obtained by calculations on shockwave dissociation coefficients. G.G.

N66-23997# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FREE OSCILLATIONS OF LIQUID IN RIGID CIRCULAR CYLINDRICAL VESSEL WITH ELASTIC FLAT BOTTOM
A. A. Pozhalostin *In its* News of Inst. of Higher Learning 6 Jan. 1966 p 31–41 refs (See N66-23994 13-01) CFSTI: HC $26.30/MF $1.25

This article presents a solution to the problem of free oscillations of a liquid in a rigid circular cylindrical vessel with an elastic flat bottom. An appraisal is given of the free surface oscillation effects on the system frequencies. It appears that an oscillatory system can be represented by a mechanical analog. R.N.A.

N66-23998# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXACT SOLUTION OF PLANE PROBLEM OF FLOW OF VISCOUS LIQUID IN DIFFUSER WITHOUT CALCULATION OF INERTIAL MEMBERS

K. P. Strashinina *In its* News of Inst. of Higher Learning 6 Jan. 1966 p 42–46 refs (See N66-23994 13-01) CFSTI: HC $26.30/MF $1.25

An exact solution is obtained for the plane problem of viscous liquid flow in a diffuser. The results are obtained by solving the differential equations defining the fluid motion without calculating the inertial members and mass forces. Details of the assumptions and methods for satisfying the boundary conditions are given, and the results are shown to compare favorably with previous solutions for small Reynolds numbers.
C.T.C.

N66-24006# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON FORM OF MIDLINE OF AXISYMMETRIC FAN STREAM IN DRIFT FLOW

V. S. Ivanov *In its* News of Inst. of Higher Learning 6 Jan. 1966 p 138–150 refs (See N66-23994 13-01) CFSTI: HC $26.30/MF $1.25

Considered is the problem of a free turbulent fan stream of incompressible liquid, submerged in an incompressible liquid of another density, in the presence of drift flow on the outside stream. In solving the problem, it was assumed that the external force is directed normally to the middle surface of the stream and is proportional to the value of the normal component of impact pressure. Additional parameters of the problem are identified and the various equations used in its solution are derived.
H.S.W.

N66-24008# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

QUESTION OF CALCULATION OF SPACE FLOW IN TURBINE STAGE WITH NONUNIFORM TEMPERATURE OF GAS AT ENTRANCE

V. I. Lokay *In its* News of Inst. of Higher Learning 6 Jan. 1966 p 159–170 refs (See N66-23994 13-01) CFSTI: HC $26.30/MF $1.25

Relationships are given for investigating the axisymmetrical cylindrical flow of the gas in a turbine stage after nozzle cascade. An equation of radial equilibrium is derived which considers the compressibility of the gas, losses in the nozzle, and irregularities in the temperature of the gas at the entrance to the turbine stage. Additionally expressions are derived for the gas velocity at the nozzle outlet, pressure and temperature beyond the nozzle, the temperature of the gas in the boundary layer near the rotor blades, the work performed by the gas on the rotor blades, the total flow rate of a gas through a stage, the isoentropic heat drop of a stage, and the efficiency at the ring of a stage.
H.S.W.

N66-24015# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON ONE CLASS OF VORTEX FLOWS

O. P. Sidorov *In its* News of Inst. of Higher Learning 6 Jan. 1966 p 244–250 ref (See N66-23994 13-01) CFSTI: HC $26.30/MF $1.25

The transition through the speed of sound is accomplished in such a way that in the flow region there appear limiting lines which result in shock waves. This article considers, in first approximation, such methods of hydrodynamic influence on flow which do not allow for the appearance of shock waves. It turns out that such a property belongs to a specially selected field of vortices.
R.N.A.

N66-24035# TRW Systems, Redondo Beach, Calif.

ACOUSTIC WAVES GENERATED BY THE MOTION OF PIPING CONTAINING A FLUID

Norman Lipner and Francis B. Fay *In* NRL The Shock and Vibration Bull., No. 35, Pt. 3 Jan. 1966 p 161–167 refs (See N66-24020 13-32) CFSTI: HC $6.00/MF $1.50
(Contract AF 04(694)-750)

This paper concerns itself with the design of hydraulic systems subjected to a shock environment. The design of such a system will be broken up into three phases: (a) the calculation of the acoustic waves that are generated at discontinuities in the system, (b) the superposition of these waves to determine what pressures will impinge on critical equipment, and (c) the design of a system modification to attenuate these pressures to tolerable levels for equipment. The purpose of this paper is to give general rules that may be used by a designer to arrive at environmental design conditions for systems of this type, and to give more insight into the problem than is presently found in pertinent literature. However, there are still some facets of the phenomenon of wave propagation through a typical hydraulic system that have not been completely defined. When these facets are encountered, conservative assumptions are introduced. Since most hydraulic systems contain equipments whose acoustic properties are difficult to handle analytically, some information concerning the system could be obtained only by testing. This paper will also describe appropriate tests which might be performed.
Author

N66-24044# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.

SOLUTION OF A NON-LINEAR BOUNDARY VALUE PROBLEM IN FLUID MECHANICS USING A VARIATIONAL METHOD

Alexander Pal Sep. 1965 81 p refs
(Contract DA-44-177-AMC-91(T))
(PIBAL-890; AD-629629) CFSTI: HC $8.60/MF $0.75

It is shown that the generalized Dirichlet integral has similar variational properties as the ordinary one, i.e., the solution of the corresponding first boundary value problem makes it minimum for given boundary values. It is shown that the compound variational functional introduced has a lower bound for a broad function class ('admissible' functions) thus permitting the formulation of the variational problem as a minimum problem. A nonlinear integral equation is derived involving only the boundary values of Q. This integral equation is essentially equivalent to the boundary value problem. With the aid of this integral equation the asymptotic estimates near 0 are improved and differentiability properties of Q on the boundary are proved.
TAB

N66-24058# Navy Dept., Washington, D. C.

NONLINEAR INTERACTION BETWEEN A SPHERICAL SHOCK WAVE AND FREE SURFACE WATER CAUSED BY THE EXPLOSION OF A DEEP CHARGE [O NELINEYNOM VZAIMODEYSTVII SFERICHESKOY UDARNOY VOLNY, VOZNIKSHEY V RESUL'TATE VZRYVA ZAGLUBLENNOGO ZARYADA SO SVOBODNOY POVERKHNOST'YU VODY]

B. I. Zaslavskiy 1966 17 p refs Transl. into ENGLISH from Prikl. Mekhan. i Tekhn. Fiz. (USSR), no. 4, 1964 p 57–65 *Its* Transl. No. 2109
(TT-66-60742; AD-629670) CFSTI: HC $1.00/MF $0.50

There was obtained a class of definite partial derivative solutions of "short wave" equations.
TAB

N66-24241# Electro-Optical Systems, Inc., Pasadena, Calif.
ON THE ACCELERATION OF SPHERES BY ONE-DIMENSIONAL NON-UNIFORM GAS FLOWS
In its Studies of Electrically Exploding Wires and Films. Studies of Crossed-Field Plasma Accelerators and Plasma Diagnostic Tech. Oct. 1965 26 p refs (See N66-24239 13-25) CFSTI: HC $6.00/MF $1.25
(Contract DA-04-045-ORD-2000)
(EOS-1690-Final, Pt. I, Append.)

The problem of determining the velocity given to a sphere, initially at rest, by the sudden expansion of a one-dimensional nonuniform gas flow, due to aerodynamic drag, is considered. The problem is formulated in terms of the mass of gas which has flowed past the sphere, m. The case of uniform flow, where every element of gas moves with the same velocity, but the local density at a point varies arbitrarily, is solved. The velocity of the sphere can also be determined when the gas mass velocity is a monotonically decreasing function of m only. The velocity of the sphere, due to the nonuniform expansion of a one-dimensional gas into vacuum, is treated analytically. In this case the terminal velocity of the sphere can be greater than the average gas velocity. Author

N66-24323# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Berlin (West Germany).
BOUNDARY LAYERS AND WALL RADIATION AT STRONGLY CURVED WALLS (COANDA-EFFECT) [GRENZSCHICHTEN UND WANDSTRAHLEN AND STARK GEKRUMMTEN WANDEN (COANDA-EFFEKT)]
R. Wille and H. Fernholz Feb. 1966 41 p refs In GERMAN; ENGLISH summary
(DLR-FB-66-06; DVL-493) CFSTI: HC $2.00/MF $0.50

The flow dynamics of the Coanda effect and its various applications in applied mechanics were discussed during this conference. Brief outlines of the theoretical and practical research studies on jet flow mechanics along a curved wall were given together with overall analyses of the deflection phenomena and mixing processes in the induced turbulent flow.
Transl. by G.G.

N66-24389*# Northrop Corp., Newbury Park, Calif.
CALCULATION OF TWO-DIMENSIONAL TURBULENT FLOW FIELDS
John G. Trulio, William E. Carr, William J. Niles, and Richard L. Rentfrow Washington, NASA, May 1966 84 p refs (Contract NAS8-11400)
(NASA-CR-430) CFSTI: HC $1.25/MF $0.75 CSCL 20D

Numerical solutions of the Navier-Stokes equations have been obtained for the flow of a compressible viscous fluid around a right circular cylinder. A computer code which solves the equations of motion of a general continuous medium for two-dimensional plane symmetric systems, was specialized to the case of a Stokesian fluid and used to solve these problems. The system with R=100, which was otherwise symmetric about a plane through the cylinder axis, was perturbed asymmetrically in order to induce vortex shedding. A vortex street developed with a shedding frequency within 10 percent of that measured experimentally. Using a fine mesh, the code predicted sizable pressure fluctuations for R=1000 in the neighborhood of the cylinder, at a dominant frequency of about 50 kilocycles. With sufficiently coarse meshes or appropriate time averages, the pressures calculated at various points of the cylinder were in fair agreement with those measured. Graphs of the pressure as a function of the cylinder angle θ are presented, as are many plots of the velocity fields obtained in the calculations. Author

N66-24429# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
THE FLOW NEAR THE REGION OF VERTEX OF AXIALLY SYMMETRIC BODIES AT SUPERSONIC SPEEDS
Keiichi Karashima Feb. 1966 35 p refs
(ISAS-400, Vol. 31, No. 1)

An analytical method for axially symmetric supersonic flow involving shock wave is presented and applied to clarify the characteristic feature of the flow near the region of vertex of the pointed bodies of revolution with arbitrary geometry. The method used in the present approach is exact except for an assumption that the flow is inviscid. It is shown that the present method can be further applied, with a slight modification, to a circular-cone with such large semi-vertex angle that the flow behind the shock wave is partially subsonic. Detailed examination reveals that in axially symmetric flow there exists a particular point which corresponds to Crocco point in plane flow and the flow characters near the region of vertex of the body are qualitatively quite the same as those of the plane flow. It is concluded that the transition from attached to detached shock wave is continuous for circular-cones as well as for plane wedges.
Author

N66-24446# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON FLUID OSCILLATIONS IN TUBES AT MODERATE REYNOLDS NUMBERS
S. I. Sergeev [1966] 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidk. i Gaza (Moscow), no. 1, 1966 p 168-170

Results of measuring the critical Reynolds number and the drag forces in the laminar and turbulent regimes of fluid oscillations in tubes are discussed. The Navier-Stokes equation is used to describe the laminar oscillations of a viscous fluid in a long tube, proceeding with a given mean velocity under the customary boundary conditions. Several cases are considered, and it is pointed out that the critical value of the Reynolds number increases in direct proportion to the inertial number. Measurements of the resistance to fluid oscillations were made, and observations were recorded for both free and kinematic fluid oscillations. Transition from the laminar to the turbulent regime occurred almost without hysteresis when the oscillation frequency was slowly raised or lowered. It was also found that the magnitude of the inertial number substantially affects the character of the fluid flow, and the transition from laminar into turbulent motion. According to the observations, the critical Reynolds number corresponding to this transition was approximately proportional to the inertial number. The test data are extended to other values, and the findings are discussed.
M.G.J.

N66-24454# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FORCED OSCILLATIONS OF A STREAM OF AN IDEAL COMPRESSIBLE LIQUID IN A HOMOGENEOUS STRAIGHT PIPE
K. S. Kolesnikov 8 Dec. 1965 18 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. i Mashinostr. (Moscow), no. 4, 1963 p 102-107
(FTD-TT-65-1119/1+2+4; TT-65-64844; AD-625060) CFSTI: HC $1.00/MF $0.50

A linear solution is proposed to the problem of a unidimensional perturbed movement of an ideal compressible liquid by a straight pipe. Features of forced oscillations are considered, and it was shown that, in the presence of resistances at the

ends of the pipe, the intensity of resonance phenomena decreases with increased velocity of the nonperturbed stream. Linearized equations are derived for the problems of determining liquid pressure variations when leaving the pipe, and variations in the speed of liquid output from the pipe. M.G.J.

N66-24477# Lockheed Missiles and Space Co., Sunnyvale, Calif.
INVESTIGATION OF THE LAMINAR BOUNDARY LAYER IN COMPRESSIBLE AND INCOMPRESSIBLE FLUIDS
G. A. Kulonen and L. A. Kulonen [1965] 13 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekh. (Kazan), no. 4, 1965 p 29–37

The boundary layer equations for a zero angle of attack flow around a plate were evaluated by utilizing the corresponding boundary conditions in the Crocco nondimensional variables to construct a solution by successive approximations of the variable transforms for two integral relations expressing the laws of momentum and energy conservation from an element of the boundary layer. Also analyzed was the motion of an incompressible fluid in the laminar boundary layer of an infinite wing by linear integration of the variables connected to the stream function. G.G.

N66-24546*# Fluidyne Engineering Corp., Minneapolis, Minn.
FLOW INITIATION STUDY FOR PROPOSED TUBE WIND TUNNEL, PHASE I. APPENDIX: RE-EVALUATION OF CANDIDATE SYSTEMS
James L. Grunnet, Donald N. Kamis, George H. Thornberg, Paul B. Hasselquist, and William B. Hamre Dec. 1965 54 p ref (Contract NAS8-20214)
(NASA-CR-74635) CFSTI: HC $3.00/MF $0.50 CSCL 20D

The Phase I report included ratings for candidate flow initiation systems in a large tube wind tunnel and a recommendation of a single system for continued development. Concurrent studies of utilization and operational characteristics of the proposed tunnel have placed renewed emphasis on the importance of interference free flow in the test section and of growth potential for filling in the transonic regime of test capability. This appendix presents a re-evaluation of flow initiation systems with accountability of the evolving utilization specifications and with consideration of possible relaxation of test frequency and operation sophistication in favor of lower initial cost and more certain shakedown to operational status. R.N.A.

N66-24647# General Electric Co., Cincinnati, Ohio. Missile and Space Div.
COMPUTER PROGRAM FOR CALCULATION OF LAMINAR BOUNDARY LAYER IN A SUPERSONIC NOZZLE
N. P. Jeffries and L. L. Cumbers 9 Jun. 1965 58 p refs (R65SD3007)

A computer program is described which is capable of computing the laminar boundary layer in an axisymmetric supersonic nozzle. The program also determines the nozzle contour which will maximize the thrust obtained under a specified set of operating conditions, taking into account the effects of the boundary layer. The boundary layer thickness is computed by using a correlation, and the optimum nozzle contour is found by an approximate method. The program was originally developed to determine the design and performance of electrothermal thrusters, but it has also been applied to supersonic nozzles for other applications such as chemical rockets and wind tunnel facilities. Author

N66-24744# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
A NOTE ON THE PROBLEM OF AN OSCILLATING SUPERCAVITATED HYDROFOIL NEAR A FREE SURFACE Final Report, Apr. 1964–Oct. 1965
John M. Grace and Irving C. Statler Oct. 1965 48 p refs (Contract NObs-90278)
(CAL-BB-1935-S-1; AD-627035) CFSTI: HC $2.00/MF $0.50

The objective of the study was to determine the steady and unsteady forces and moments on a fully cavitated hydrofoil operating near a free surface. The approach assumed linearized, two-dimensional, potential flow but no further limitations were placed on the values of Froude number, cavitation number, or depth-to-chord ratio. Full account was taken of the gravity waves on both the air–water and cavity interfaces generated by the motion of the foil–cavity system. The report discusses the approach to the general problem based on a representation of the system by distributions of elemental singularities. The solution for the steady motion of a deeply submerged, supercavitated, flatplate foil is obtained in this manner. Author (TAB)

N66-24774# Oklahoma State Univ., Stillwater.
VISCOSITY STUDIES ON DISTILLED WATER AND WEAK SOLS OF POLYETHYLENOXIDE USING THE FALLING CYLINDER VISCOMETER
E. Rune Lindgren Oct. 1965 36 p refs
(Contract Nonr-2595(05))
(TR-3; AD-629610) CFSTI: HC $2.00/MF $0.50

An experimental investigation was undertaken on the viscosity of weak sols of polyethylenoxide of molecular weight 4,000,000 in distilled water. At 0.01% concentration the viscosity is about 5% higher than for distilled water. Thus, remarkable reduction of turbulent energy losses observed for concentrations of 0.002–0.006% does occur without noticeable viscosity changes. The investigation revealed that the standard theory for the falling cylinder viscometer appears to be in error. Author (TAB)

N66-24836# Aerodynamische Versuchsanstalt, Gottingen (West Germany).
TURBULENT BOUNDARY LAYERS WITH BLOWOFF FROM COLD AND WARM AIR THROUGH A PERFORATED OR SLOTTED WALL [TURBULENTE GRENZSCHICHTEN MIT AUSBLASEN VON KALTER AND WARMER LUFT DURCH EINE GELOCHTE ODER GESCHLITZTE WAND]
W. Wuest 13 Oct. 1964 68 p refs In GERMAN
(Rept.-64-A-37) CFSTI: HC $3.00/MF $0.75

Velocity and temperature profiles of turbulent boundary layers, caused by suction of cold and warm air through plates with slits and holes as well as from porous cylinders, were measured in a wind tunnel flow of 40 m/s. Velocity data were then used to calculate the diffusion thicknesses of the turbulent boundary flows. It was found that the turbulent layer thicknesses increased at decreasing wind velocities and almost stabilized at 30 m/s when hot air was used.
Transl. by G.C.

N66-24838# Aerodynamische Versuchsanstalt, Gottingen (West Germany).
TWO GAS BOUNDARY LAYERS IN THE REGION OF FREE STAGNATION POINTS IN INCOMPRESSIBLE FLOW WITH REGARD TO THE THERMAL DIFFUSION [ZWEIGAS-GRENZSCHICHTEN IN DER UMGEBUNG EINES FREIEN STAUPUNKTES IN INKOMPRESSIBLER STROMUNG MIT BERUCKSICHTIGUNG DER THERMISCHEN DIFFUSION]

W. Wuest 4 Nov. 1964 48 p refs In GERMAN
(Rept.-64-A-40) CFSTI: HC $2.00/MF $0.75

The formation of a thermal insulation layer by forward ejection of a gaseous medium other than air from a supersonic nose orifice was studied. An iterative solution, utilizing Navier–Stokes equations, was obtained for an ideal laminar boundary layer with stagnation point flow that considered the thermal diffusion betweeen the two separated gases as well as the gaseous diffusion induced by the density variation of the gases. It was shown that the thermal diffusion was minimal when the ejected helium gas was colder than the surrounding air. Transl. by G.G.

N66-24841# Aerodynamische Versuchsanstalt, Gottingen (West Germany).

TURBULENT BOUNDARY LAYERS WITH PRESSURE GRADIENTS AND HEAT TRANSFER

J. C. Rotta 7 Jul. 1964 40 p refs Presented at 21st AGARD Fluid Dyn. Panel on Develop. in Boundary Layer Res., Lisbon, 14–15 Sep. 1964
(Rept.-64-A-26) CFSTI: HC $2.00/MF $0.50

A brief review is given on the recent development in turbulent boundary layers. At first, for the case of incompressible flow, the variation of the shape of velocity profile with the pressure gradient, as well as the temperature distribution and heat transfer are treated. Furthermore, problems of the turbulent boundary layer in compressible flow are discussed. Author

N66-24848# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.

SOME DEVELOPMENT OF MARKOFF'S METHOD OF RANDOM FLIGHTS, WITH THE INTENTION OF APPLICATION TO TURBULENT FLOW

Toyoki Koga Nov. 1965 34 p refs
(Contract Nonr-839(38); ARPA Order-529; Proj. Defender) (PIBAL-954; AD-477798)

Markoff's method of random flights is reconsidered and developed with the intention of applying it to problems of turbulent flow. The gist is to generalize the assumption regarding the probability distribution of casual events. (1) Correlations which may exist among casual events, and the consequences appearing in the resultant events are considered. In view of the conclusion, some of the previous authors' treatments are criticized. (2) The correlation probability between two resultant events which are separated in space but caused by a common group of causal events is formulated. (3) The correlation probability between two events separated in time but caused by the same group of casual events evolving in time is formulated. Author (TAB)

N66-24892# Institut Franco-Allemand de Recherches, St. Louis (France).

DIFFRACTION OF A SHOCK WAVE UPON ENTERING A SUBTERRANEAN WIND TUNNEL, PART I [DIFFRACTION D'UNE ONDE DE CHOC A L'ENTREE D'UNE GALERIE SOUTERRAINE, IERE PARTIE]

Imp Thery and C. Laurent 30 Dec. 1964 27 p In FRENCH
(ISL-T-44/64) CFSTI: HC $2.00/MF $0.50

The protection furnished by an obstacle placed at the entrance to an underground wind tunnel against shock waves was investigated. The effects of the obstacle on shock wave diffraction and propagation were determined by studying interferometer photographs. The results show that it is possible to reduce substantially the level of high pressure at the interior of the tunnel. Transl. by D.T.

N66-24911*# National Aeronautics and Space Administration, Washington, D. C.

REPRESENTATION OF THE EQUATION OF STATE OF A REAL GAS BY ELEMENTARY FUNCTIONS, AND METHODS OF THEIR DETERMINATION [PREDSTAVLENIYE URAVNENIYA SOSTOYANIYA REAL'NOGO GAZA CHEREZ ELEMENTARNYYE FUNKTSII I METODIKA IKH OPREDELENIYA]

Ya. Z. Kazavchinskiy Apr. 1966 15 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 7, no. 6, 1964 p 129–134
(NASA-TT-F-10078) CFSTI: HC $1.00/MF $0.50 CSCL 20D

The equation of state of a real gas in terms of elementary functions is derived over a wide range of density variation, including the saturation curve and the liquid phase region, from experimental data of the gas phase. The equation is valid for the entire one-phase region, including the liquid phase. The temperature functions, derived from the gas phase data, are used to describe the liquid phase. Calculation by computer is outlined, with reference to nitrogen. Author

N66-24912*# National Aeronautics and Space Administration, Washington, D. C.

TURBULENT BOUNDARY LAYER ON A FLAT PLATE IN AN INCOMPRESSIBLE FLUID [TURBULENTNYY POGRANICHNYY SLOY NA PLOSKOY PLASTINE V NESZHIMAYEMOY ZHIDKOSTI]

G. S. Glushko Apr. 1966 29 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Mekhan. (Moscow), no. 4, 1965 p 13–23
(NASA-TT-F-10080) CFSTI: HC $2.00/MF $0.50 CSCL 20D

Effective viscosity is shown to be universal for turbulent boundary-layer flows and to be independent of the presence of a pressure gradient. An analytical relation between the effective viscosity and the turbulent Reynolds number is derived from processed measurements of the turbulence characteristics. With this relation, it is possible to use only one equation for the total turbulent energy. A system of differential equations consisting of the Reynolds equation, the equation of total turbulent energy, an empirical distribution of the turbulence scale, and an empirical relation for the dissipation energy was integrated on an electronic digital computer. The solution obtained exhibits a laminar, a turbulent, and a transition region. The velocity distribution and distribution of total turbulent energy are obtained, and a relation between the friction coefficient and Reynolds number is derived. The results are compared with the experiment. Author

N66-24940*# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

INTEGRAL METHODS IN COMPRESSIBLE LAMINAR BOUNDARY LAYERS AND THEIR APPLICATION TO HYPERSONIC PRESSURE INTERACTIONS

Yat-Yung Chan Jan. 1965 108 p refs
(Grant NsG-633)
(NASA-CR-74707; UTIAS-104; AD-462025) CFSTI: HC $4.00/MF $0.75 CSCL 01A

A method is presented for calculating the properties of compressible laminar boundary layers with heat transfer and arbitrary pressure gradients. The method is based on the concept of combining integral relations and similarity solutions. It differs, however, from the classical technique in that both the momentum and the energy integral equations are used. The method is applied to calculate the self-induced pressure interaction problem in hypersonic flows. The solutions cover the complete range of interaction and show good agreement with other more exact theoretical results as well as experimental

data. The pressure interaction problem is also considered for real gases using weakly dissociated boundary layers. Calculations are presented for a flat plate with a fully catalytic surface in a stream of oxygen. The results show that under these conditions the boundary layer characteristics vary only slightly from the perfect gas case. Author (TAB)

N66-24943*# RAND Corp., Santa Monica, Calif.
TOLERANCE AND CONFIDENCE LIMITS FOR CLASSES OF DISTRIBUTIONS BASED ON FAILURE RATE
Richard E. Barlow and Frank Proschan Mar. 1966 40 p refs (Contract NASr-21(11))
(NASA-CR-71310; RM-4914-NASA) CFSTI: HC $2.00/MF $0.50 CSCL 12B

The validity of exponential tolerance and confidence limits are extended, under certain restrictions, to classes of distribution based on failure rate. In particular, the usual exponential lower tolerance limit is shown to be conservative for the increasing failure rate class of distributions in the range of population coverages and confidence coefficients of practical interest. Conservative confidence limits are also obtained on the mean. Definitions are given for the increasing failure rate (IFR) and decreasing failure rate (DFR) distributions, and for distributions whose failure rate increases on the average (IFRA) or decreases on the average (DFRA). Equations are derived for the upper and lower tolerance limits, and upper and lower confidence limits for percentiles and for the mean for IFR or IFRA distributions; and for the upper and lower tolerance limits, and a lower confidence limit for the mean for DFR or DFRA distributions. M.G.J.

N66-24946*# North American Aviation, Inc., Downey, Calif. Launch Vehicle Dynamics Group.
A STUDY OF LONGITUDINAL OSCILLATIONS OF PROPELLANT TANKS AND WAVE PROPAGATIONS IN FEED LINES. PART I: ONE-DIMENSIONAL WAVE PROPAGATION IN A FEED LINE
Henry Wing and Clement L. Tai 31 Mar. 1966 126 p refs (Contract NAS8-11490)
(NASA-CR-74739; SID-66-46-1) CFSTI: HC $4.00/MF $1.00 CSCL 20D

In this report, the dynamics of elastic propellant feed lines with streaming fluid are analyzed using the nonlinear one-dimensional unsteady compressible fluid flow equations. The viscous effect of the fluid is assumed to be expressible in the form of a hydraulic resistance corresponding to turbulent flow. Transfer functions relating the pressures, velocities, and the corresponding phase angles were derived from the linearized equations for the perturbed state. The governing equations were also converted into a system of four first-order ordinary nonlinear differential equations by the method of characteristics. These were then transposed into finite difference form and solved numerically on a digital computer. Impulse, step, and sinusoidal velocity disturbances were considered in the numerical solution for a feed line with and without a control device. The physical parameters of the liquid hydrogen line on the Saturn S-II engine are used for the numerical calculations to illustrate the results. Author

N66-24947*# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
A STUDY OF LONGITUDINAL OSCILLATIONS OF PROPELLANT TANKS AND WAVE PROPAGATIONS IN FEED LINES. PART II: WAVE PROPAGATION IN ELASTIC PIPE FILLED WITH INCOMPRESSIBLE VISCOUS FLUID
Michael M. H. Loh and Clement L. Tai 21 Jan. 1966 55 p refs (Contract NAS8-11490)
(NASA-CR-74740; SID-66-46-2) CFSTI: HC $3.00/MF $0.50 CSCL 20D

An analysis was made of pressure waves being propagated through a system at rest, as part of a study of longitudinal wave propagation in an elastic pipe filled with an incompressible and viscous fluid. The influence of pipe wall inertia on wave propagation and its correlation with fluid viscosity was studied. The mathematical model was formulated by deriving a characteristic equation from elastic equilibrium of the pipe and Navier–Stokes fluid flow. Two sets of phase velocities and attenuation factors were obtained from the reduced characteristic equation for various viscosity and inertia parameters. The phase velocities and attenuation factors were obtained as longitudinal and radial inertia parameters representing pipe wall inertia and a viscosity parameter. The relations are delineated in the form of graphs. E.A.O.

N66-24952*# California Univ., Berkeley. Coll. of Engineering.
STUDY OF NONEQUILIBRIUM TWO-PHASE FLOW OF A GAS-PARTICLE MIXTURE Technical Note No. 2
R. L. Panton and A. K. Oppenheim Mar. 1966 223 p refs (Grant NsG-702)
(NASA-CR-74767; AS-66-5) CFSTI: HC $6.00/MF $1.25 CSCL 20D

The problem of a two-phase nonequilibrium flow of particle suspensions in a gaseous medium is formulated, including the effects brought about by the change of phase that takes place in the case of a liquid-gas mixture. On this basis the relaxation zone behind a shock wave passing through a system of liquid droplets dispersed in a gaseous carrier is analyzed. Allowance is made for the presence of two sizes of particles, but specific effects of drop shattering are neglected. The solution is programmed in Fortran and its application to a particular system is illustrated by the case of n-dodecane droplets in oxygen. Author

N66-24996*# Mississippi State Univ., State College. Engineering and Industrial Research Station.
RESEARCH STUDY FOR DETERMINATION OF LIQUID SURFACE PROFILE IN A CRYOGENIC TANK DURING GAS INJECTION Quarterly Progress Report No. 7, 19 Dec. 1965–18 Mar. 1966
E. K. Bishop, W. D. Mc Cain, Jr., R. E. Forbes, W. S. Cagle, and J. T. Smith [1966] 47 p refs
(Contract NAS8-11334)
(NASA-CR-74724) CFSTI: HC $2.00/MF $0.50 CSCL 20D

Progress is reported in a program to determine the liquid surface profile in a cryogenic tank during gas injection. Motion pictures of the surface disturbance caused by swarms of nitrogen bubbles rising in distilled water were analyzed and surface profiles plotted from data taken from the film. The data for one inlet gas flow rate was fitted to the fourth degree polynomial, $Z_c = .295\,[1 - .050\,|r| - .086\,|r|^2 - .262\,|r|^2 + .077\,|r|^4]$ with good agreement. The rates at which water is entrained by a saturated air stream were experimentally determined for a modified U-tube configuration as a function of air delivery pressure. The water removal rate was determined for various gas delivery pressures and percentage of the horizontal pipe filled with water. Tests were first conducted by gradually increasing the gas delivery pressure until the desired pressure was achieved; then they were repeated by impacting the test section with the same pressures. Curves of the measured entrainment rates for each case studied are presented. Detailed qualitative descriptions and sketches of the flow phenomena in the horizontal and vertical pipes are given, as well as photographs of the flow at sections of particular interest. Author

N66-25022*# National Aeronautics and Space Administration, Washington, D. C.

THREE-DIMENSIONAL FLOW OF IDEAL GAS PAST SMOOTH BODIES

K. I. Babenko, G. P. Voskresenskiy, A. N. Lyubimov, and V. V. Rusanov Apr. 1966 522 p refs Transl. into ENGLISH of the book "Prostranstvennoye Obtekaniye Gladkikh Tel Ideal'nym Gazom" Moscow, Izd. Nauka, 1964

(NASA-TT-F-380) CFSTI: HC $5.50/MF $2.50 CSCL 01A

The flow field near a smooth body arbitrarily placed with respect to the incident airflow was computed. In terms of mathematics, the problem was reduced to solving a boundary value problem for a system of nonlinear equations with partial derivatives containing three independent variables. The system of finite difference equations is described in detail, along with the method of calculation; and an account is presented of the method's application to other problems of mechanics and mathematical physics. The results of the calculations for nonaxisymmetric flow about several bodies of revolution are given, and the chemical reactions for some of the different shapes are described. Tables are presented on the gas flow for the field about cones in a wide range of Mach numbers, half cone angles, and angles of attack. D.T.

N66-25156# Bendix Corp., Southfield, Mich. Research Labs. Div.

PHENOMENOLOGY OF VORTEX FLOW AND ITS APPLICATION TO SIGNAL AMPLIFICATION

Lael B. Taplin 1 Oct. 1965 68 p refs Presented at the Summer Eng. Seminars on Fluid Control Systems at Univ. Park, Pa., 6-16 Jul. 1965

(RLDP-65-14, Rev. I)

This paper delineates various experimental phenomena associated with pancake vortex chambers and presents both qualitative and quantitative explanations of these observations. Mathematical models are presented for both incompressible and compressible flow cases. Correlation of the mathematical model with experimental data is demonstrated. Both static and dynamic performance of the vortex flow field is analyzed. The paper concludes by showing actual performance data for some typical vortex amplifiers and some circuit techniques which utilize these amplifiers. Author

N66-25167# Lockheed Missiles and Space Co., Sunnyvale, Calif.

ON THE INFLUENCE OF FLUCTUATIONS IN THE ENERGY DISSIPATION ON THE FORM OF THE TURBULENCE CHARACTERISTICS IN AN INERTIAL INTERVAL

A. M. Iaglom 12 Apr. 1965 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 166, no. 1, 1966 p 49-52

This note is presented to demonstrate the fact that a formula of the type $E_{\varepsilon}^{[1]}{}_{\varepsilon_1}(k) \sim k^{-0.6}$ may be derived and related to expressions for deviations of the statistical characteristics of turbulence from the two-thirds and five-thirds laws in an inertial interval. This would admit, at least in principle, independent experimental verification. R.N.A.

N66-25169# Oklahoma Univ. Research Inst., Norman. Atmospheric Research Lab.

MOTION OF THE VORTEX WITH PRESSURE AND INFLOW WHICH ARE NOT CIRCULAR SYMMETRY

Yoshikazu Sasaki and Sigekata Syono (Tokyo Univ.) Feb. 1966 68 p refs

(Grant NSF GF-172)

(ARL-1470-3)

The two-dimensional motion of a vortex is discussed, which has noncircular symmetric patterns of pressure and inflow and moves in a flow of a constant vorticity under the influence of Coriolis force. The nonsymmetric vortex is idealized by a combination of a point vortex and a doublet. The doublet represents an essential three-dimensional characteristic which appeared in the hurricanes, typhoons, and thunderstorms of the atmosphere. The necessary equations which govern the motion of the vortex are derived. Associated pressure distribution of the first and second orders around the vortex is discussed. The motions of a vortex due to Magnus effect and of a circular cylinder in a rotating flow are included in the equations as special cases. New terms have appeared in the equations, which are due to the doublet and causes an asymmetric pattern of inflow around the vortex. These are the products between the magnitude of the first order of asymmetric inflow and the Coriolis parameter, the vorticity of the flow, and the circulation of the vortex. It is shown that the vortex moves with the velocity different from that of the basic flow and that the new terms due to the doublet are the prime importance for such a motion. Author

N66-25198# Lockheed Missiles and Space Co., Sunnyvale, Calif.

INTEGRATION OF THE THREE-DIMENSIONAL BOUNDARY LAYER EQUATIONS WITH SUCTION OR BLOWING

L. F. Kozlov 17 Nov. 1964 11 p refs Transl. into ENGLISH from Prikl. Mekh. (Moscow), v. 2, no. 2, 1966 p 110-116

The Prandtl partial differential equations for the three-dimensional laminar boundary layer of a plate with a parabolic external flow are reduced to ordinary differential equations. Using the "Minsk-1" electronic computer, exact solutions of the equations are obtained herein for the case of a permeable surface with suction or blowing. Analysis of the results of the solutions showed that suction of the fluid through the permeable surface is an effective means of diminishing or liquidating secondary flows in the three-dimensional boundary layer. Author

N66-25219# Los Alamos Scientific Lab., N. Mex.

THREE-DIMENSIONAL CARTESIAN PARTICLE-IN-CELL CALCULATIONS

William R. Gage and Charles L. Mader 11 Jan. 1966 68 p refs

(Contract W-7405-ENG-36)

(LA-3422) CFSTI: HC $3.00/MF $0.75

A study of the Particle-In-Cell method of numerically solving hydrodynamic problems in three dimensions is described. The closure of a cubical void in a cubical box was successfully computed. Various methods, including stereoscopic views, of pictorial description of the particle positions are described. Author

N66-25238 Southwest Research Inst., San Antonio, Tex. Dept. of Aerospace Propulsion Research.

FUNDAMENTAL INVESTIGATION OF LIQUID-METAL LUBRICATED JOURNAL BEARINGS Quarterly Technical Report No. 4, Apr. 1-Jul. 31, 1965

R. A. Burton, H. J. Carper, and Y. C. Hsu 1 Aug. 1965 85 p refs

(Contract AT(11-1)-1228)

(SUR-1228-67; RS-457) CFSTI: HC $3.00/MF $0.75

The momentum and continuity equations for a turbulent fluid are integrated across a thin film with arbitrary thickness variation. Velocity profile and friction parameters required for the solution of these equations are calculated for the power-law

approximation. The results are applied to calculation of pressures in a short-full journal bearing and a tilted pad without end leakage, showing good agreement with experimental measurements. Experimental velocity profile data are reported which should help in future improvement of the computations. Author (NSA)

N66-25243# Argonne National Lab., Ill.
PROPAGATION OF DENSITY DISTURBANCES IN AIR-WATER FLOW
George P. Nassos Jun. 1965 126 p refs
(Contract W-31-109-ENG-38)
(ANL-7053) CFSTI: HC $4.00/MF $0.75

The behavior of density waves propagating vertically upwards in an atmospheric-pressure air-water system was investigated. A square-wave pattern was imposed on the solenoid valve controlling the secondary air flow, resulting in a regular sequence of density disturbances. Two air-water mixers were used for producing the primary air-water flow and the secondary perturbations. Twenty runs were made in which the steady-state air flow, the perturbation air flow, and the liquid velocity were varied. A plot of computer results depicted qualitative agreement with the kinematic wave theory. A comparison of the experimental propagation velocity with predictions from the kinematic wave theory showed fairly good agreement, but there was a tendency, at low mixture velocities, for the experimental velocity to be greater than the theoretical velocity; for large mixture velocities, the reverse was true. A comparison of the experimental decay rate with that predicted by the kinematic wave theory showed, in general, a perturbation decay rate considerably higher than predicted. Steady-state data were plotted on a V_g-versus-V_m plane, and the points, in general, could be described by a straight line with a slope of $C_0=1.1$ and an intercept of $V_d=0.7$ ft/sec. This value of C_0 would indicate flat velocity and concentration profiles, while experimental data showed concentration profiles described by a one-third or one-fourth power law distribution. The time-averaged transient data were also plotted on a V_g-versus-V_m plane resulting in a rather straight line with a slope of $C_0=1.2$ and $V_d=1.0$ ft/sec. The difference between the steady-state data and time-averaged transient data may be attributed to he fact that $dC_0/dt \neq 0$, and that both C_0 and V_d may be functions of the mixture velocity. NSA

N66-25244# Los Alamos Scientific Lab., N. Mex.
A STUDY OF TRUNCATION ERRORS IN EULERIAN HYDRODYNAMICS
H. J. Longley 3 Jan. 1966 33 p refs
(Contract W-7405-ENG-36)
(LA-3407) CFSTI: HC $2.00/MF $0.50

A numerical and analytical study is given of the effects of truncation errors for various differencing schemes in Eulerian hydrodynamics. Space truncation errors are studied for a conventional second order time scheme. Correlations can be made between the analytical theory and the numerical calculations. Author (NSA)

N66-25356# California Univ., Livermore. Lawrence Radiation Lab.
THE USE OF ONE-DIMENSIONAL AND TWO-DIMENSIONAL HYDRODYNAMIC MACHINE CALCULATIONS IN HIGH EXPLOSIVE RESEARCH
Mark L. Wilkins 29 Oct. 1965 22 p refs
(Contract W-7405-ENG-48)
(UCRL-14531) CFSTI: HC $2.00/MF $0.50

Hydrodynamic calculations in conjunction with experiments provide an effective method for obtaining otherwise inaccessible information on high explosives. The credibility of the calculational program (code) is established by comparison with the steady state solutions for certain detonation problems obtained by the method of characteristics. The machine calculation is then applied to specific problems in one and two dimensions to explain some of the difficulties an experimenter would encounter in attempting to measure the pressure at a detonation front. Author (NSA)

N66-25385# Minnesota Univ., Minneapolis. St. Anthony Falls Hydrau ic Lab.
ON THE EXISTENCE OF ZERO FORM-DRAG AND HYDRODYNAMICALLY STABLE SUPERCAVITATING HYDROFOILS Final Report
R. Oba Nov. 1965 53 p refs *Its* Tech. Paper No. 54, Ser. B
(Contract Nonr-710(24))
(AD-630354) CFSTI: HC $5.60/MF $0.50

The linearized complex acceleration potential is obtained for a hydrofoil of arbitrary shape in steady motion beneath a free surface with cavity of infinite length in simple and compact form. Under appropriate limiting conditions, it is shown that the solutions obtained from this potential reduce to the known solutions of Green for a planing foil, and of Auslaender and Hsu for a flat plate foil with or without flat flap near the free surface. Using some numerical results obtained from the complex potential, it is shown that there exists theoretically a supercavitating hydrofoil with finite lift coefficient and zero form drag. It is also shown that there exists theoretically a supercavitating hydrofoil with stable characteristics when shallowly submerged; that is, the lift coefficient increases as the submergence increases. Possible shapes for these hydrofoils are suggested so that the free streamlines from the leading edges do not intersect the foil surface (the hydrofoils are physically real) and so that the pressure on the pressure surface is everywhere greater than cavity pressure and less than stagnation pressure (except near the leading and trailing edges). Author (TAB)

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N66-23891# RAND Corp., Santa Monica, Calif.
EQUATORIAL TRANSMISSION OF GEOMAGNETIC MICROPULSATIONS THROUGH THE IONOSPHERE AND LOWER EXOSPHERE
E. C. Field and C. Greifinger Feb. 1966 31 p refs
(RM-4858; AD-628893) CFSTI: HC $3.60/MF $0.50

Part of a continuing study on the detection of high altitude nuclear explosions. The memorandum reports on low frequency hydromagnetic waves similar to those generated by such explosions, and detectable by ground-current measurements at worldwide locations. Particular attention is given to the response of the ionosphere to such low frequency hydromagnetic disturbances. The purpose is to separate the effects of the medium from those of the source on the transmitted disturbance. Author (TAB)

N66-23899# American Meteorological Society, Boston, Mass.
THE RELATION BETWEEN THE THERMODYNAMIC STATE OF THE ATMOSPHERE AND RADAR ECHOES FROM A CLEAR SKY [O SVIAZI MEZHDU TERMODINAMICHESKIM SOSTOIANIEM ATMOSFERY I RADIOLOKATSIONNYMI OTRAZHENIIAMI OT IASNOGO NEBA]
E. M. Sal'man and G. B. Brylev. Bedford, Mass., AFCRL, Dec. 1965. 10 p. refs. Transl. into ENGLISH from Gl. Geofizicheskaia Observ., Tr. (Leningrad), no. 159, 1964. p 85–88
(Contract AF 19(628)-3880)
(T-R-530; AD-628971) CFSTI: HC $1.00/MF $0.50

An analysis of the results of aerological and meteorological observations shows that a discrete-coherent radar echo is found in thermal convection. A correlation is noted between the maximum height of occurrence of this radar echo and the buoyancy on days with free convection. Author (TAB)

N66-23922# Technische Hochschule, Karlsruhe (West Germany).
INVESTIGATIONS ON THE NONELASTIC BEHAVIOR OF THE UPPER MANTLE Quarterly Narrative Progress Report No. 1, 1 May–31 Jul. 1965
Stephan Mueller and Karl Fuchs. 15 Aug. 1965. 14 p. refs
(Contract AF-61(052)-861; ARPA Order 612-1; Proj. Vela-Uniform)
(AFOSR-65-2939; AD-628068) CFSTI: HC $1.00/MF $0.50

The distorting effect of the earth's crust on the spectrum of seismic signals which are transmitted from the source through the mantle to the receiving station is discussed. In an attempt to correct for the influence of the 'receiver-crust' a crustal model for the region of the Grafenberg Observatory (GGGR) near Nurnberg, Germany, has been derived. Its main features are a positive velocity gradient at the top of the crystalline basement, a low-velocity channel at a depth of about 10 km, and the possible existence of a high-velocity layer just above the MOHOROVICIC discontinuity. The presence of this layer could be detected from the spectra of body waves. Author (TAB)

N66-23947# Illinois Univ., Urbana. Electrical Engineering Research Lab.
IONOSPHERIC RESEARCH Ninth Quarterly Progress Report, 1 Oct.–31 Dec. 1965
Harold D. Webb. [1966] 18 p
(Contract DA-36-039-AMC-03703(E))
(Rept.-9; AD-629449) CFSTI: HC $1.60/MF $0.50

Moon-reflected signals at 150.6 mcps were received on 34 days for a total of approximately 252 hours. Moon-reflected signals at 413.25 mcps were received on all of these days. The Faraday rotation angles have been read from the strip charts obtained at the two frequencies. The data at 413.25 mcps are used to resolve the NX180° ambiguity in the 150.6 mcps data. Calculations of electron content have been completed for the observations through November 3, 1965. The California Computer Products plotter has been used to plot the Faraday rotation and electron content values for all of the data from July 1961 through 1964 and for some of the 1965 data. An atlas of Faraday rotation and electron content data for July 1961 through 1964 is being prepared under contract AMC 01710(E). The data has been machine plotted and the graph sheets are being prepared. A phase lock receiver has been designed and built for use in keeping the 150.6 mcps receiver on signal. Two bioconical, spiral, circularly polarized antennas have been designed, built and tested. These antennas were designed for use in measuring the depolarization at the surface of the moon. Author

N66-23948# New York Univ., N. Y. Dept. of Meteorology and Oceanography.
AN INVESTIGATION OF THE INTERMEDIATE SALINITY MAXIMUM IN THE EQUATORIAL ATLANTIC DURING EQUALANT I
Robert Glenn Williams. Feb. 1966. 103 p. refs
(Contract Nonr-285(57))
(TR-66-4; AD-629156) CFSTI: HC $4.00/MF $0.75

The distribution of salinity, mass, and the circulation in the upper 500 meters of the Atlantic between 10°N and 10°S is investigated by analysis of Equalant I data. Particular attention is given to locating the sources of high salinity feeding the equatorial undercurrent, and to determining the nature and extent of the intermediate salinity maximum layer. This layer is shown to exist everywhere, except in the Gulf of Guinea south of 7° 30'S, and in a very small patch off Cape Orange, centered at 9°N, 38°W. There is a discrepancy between this result and Defant's vertical circulation model in the western South Atlantic. The sources of high salinity core of the equatorial undercurrent are the highly saline water masses lying close to the South American continent, both north and south of the equator. There are no significant intrusions of high salinity into the equatorial undercurrent east of 37°W, although the high salinity core of the undercurrent is identified as far east as 3° E. Author

N66-23951# Illinois Univ., Urbana. Electrical Engineering Research Lab.
IONOSPHERIC RESEARCH Eighth Quarterly Progress Report, 1 Jul.–30 Sep. 1965
Harold D. Webb. [1966] 47 p. refs
(Contract DA-36-039-AMC-03703(E))
(Rept.-8; AD-629430) CFSTI: HC $4.60/MF $0.50

Moon reflected signals were received for 360 hours or 39 days at 150.60 mc, and for 38 days at 413.25 mc. The n×180 degrees ambiguity can probably be resolved on all of the days. A program has been written for using the California Computer Products plotter, which can be programmed to draw grid lines, label coordinates and write captions as well as plot curves. This plotter is to be used for the Faraday rotation angle and electron content plotting. The 150.6 mc receiver is being converted into a phase-locked receiver which will automatically stay tuned to the incoming signal. A biconical spiral antenna for receiving circular polarization at 150.6 mc has been built and tested. Some modifications are required before the antenna can be made operational. A thesis for the MS degree, dealing with electron and ion temperature measurements for October 1964, is appended. Author (TAB)

N66-23953# Army Engineer Geodesy, Intelligence and Mapping Research and Development Agency, Fort Belvoir, Va.
SATELLITE ANGULATERATION
Armando Mancini. Dec. 1965. 30 p. refs
(GIMRADA-RN-16; AD-629705) CFSTI: HC $2.00/MF $0.50

A technique of utilizing combined optical and ranging data from satellites is described which leads to the determination of the total station-to-station vector. The application of this technique over the normal space trilateration for certain networks can produce an accuracy improvement of 2 to 1. Author (TAB)

N66-23967# Texas Univ., Austin. Electrical Engineering Research Lab.
AN INVESTIGATION OF THE MAGNETOTELLURIC METHOD FOR DETERMINING SUBSURFACE RESISTIVITIES

George H. Hopkins, Jr. and Harold W. Smith 1 Feb. 1966 126 p refs
(Contract Nonr-375(17))
(Rept.-140; AD-629071) CFSTI: HC $4.00/MF $0.75

A series of micropulsation recordings was made at two locations in the Delaware Basin of West Texas. Magnetotelluric resistivity soundings have been computed from this data in the range of 0.0003 to 10.0 cps. Considerable attention is devoted to the computation techniques involved, which include power spectrum analysis, digital prewhitening and alias filtering, and decimation. Horizontally stratified earth models are derived from the data with the aid of a computer program which calculates and plots apparent resistivity and phase curves, including source dimension effect, for up to a 40 layer model, allowing 12 parameter permutations. The models, which represent penetration depths from about 400 m to over 100 km, are compared with available geologic information. Source dimension effects are shown to be negligible for spatial wavelengths exceeding 600 km. An anisotropy in the data is investigated with the aid of a computer program which performs a virtual rotation of the measurement axes and determines the variation with frequency of the azimuth of apparent resistivity extremes. The source of the anisotropy seems to be in the basement rocks more than 6.4 km deep. Author

N66-23988# Georgia Experiment Station, Experiment.
INVESTIGATION OF THIN SAMPLES OF MINERAL ROCK UNDER CONDITIONS OF SHEAR DUE TO TORSION AND UNIDIRECTIONAL STRESS
M. P. Volarovitch, T. Ya. Gorazdovskii, and E. I. Parkhomendo Bedford, Mass., AFCRL, Dec. 1965 19 p refs Transl. into ENGLISH from Tr. Inst. Geol. Nauk, Akad. Nauk SSSR (Moscow), no. 2, 1953 p 230–236
(Contract AF 19(628)-5034)
(G-T-R-65-9; AD-629046) CFSTI: HC $1.00/MF $0.50

Mineral rock samples under stresses up to 50,000 kg/cm^2 were studied to determine the effect of dynamic metamorphism on rocks and minerals. The apparatus made of high strength annealed steel, is described. Thin wafers of basalt, diabase, granite, limestone, dolomite, and syenite were examined. The wafer was subjected to uniaxial but nonuniform compression, and the elastic and plastic deformation stages were determined. After release of the pressure it was found that the samples assumed a lenticular shape. Calculations showed that the smaller the radius of curvature, the greater was the difference between the normal stress on the center and the averaged surface. Smooth curves were obtained for the plots of the shearing force due to torsion versus the magnitude of the unidirectional stress. In some experiments, especially with dolomite, an explosion occurred, at times accompanied by luminous effects, smoke and disintegration of the rock into fine powder. X-ray diffraction patterns were obtained for these samples during the experiments and after the explosion. The phenomenon is discussed, and a hypothesis is proffered for the explanation of the explosive ruptures. N.E.N.

N66-23981# California Univ., Berkeley. Space Sciences Lab.
SOME SPECTRAL CHARACTERISTICS OF GEOMAGNETIC VIBRATIONS
Ruben Zrlwer 31 Jan. 1966 148 p refs *Its* Ser. No. 7, Issue No. 5
(Contract Nonr-222(89))
(AD-629087) CFSTI: HC $14.60/MF $1.00

Standard magnetograms of 14 stations distributed around the world were analyzed by means of a running power spectrum technique in an attempt to detect what may be interpreted as changes in the state of the magnetosphere from the shift of the frequency peaks of the power spectrum analyses. The event chosen was the magnetic storm of October 7, 1962, at which time the Mariner II spacecraft was on its way to Venus. The results show that the technique used is not very appropriate for the objective, for the presence of an important event of large amplitude on the data, even if it is of a very short duration, will greatly determine the character of the power spectrum. It is shown that the phenomenon is of world wide nature as detected from the technique used, but no conclusions can be drawn from the geographic distribution of occurrence of the spectral peaks. The work also includes a survey of the power spectrum analysis techniques as well as the results of some spectral computation experiments. Author

N66-23985# American Meteorological Society, Boston, Mass.
THE COORDINATE-DOPPLER METHOD OF WIND OBSERVATION [KOORDINATNODOPPLEROVSKII METOD VETROVYKH NAVLIUDENII]
A. G. Gorelik, V. V. Kostarev, and A. A. Chernikov Bedford, Mass., AFCRL, Dec. 1965 10 p Transl. into ENGLISH from Tr. Tsentral. Aerologicheskaia Observ. (Moscow), no. 57, 1964 p 19–23
(Contract AF 19(628)-3880)
(T-R-512; AD-628974) CFSTI: HC $1.00/MF $0.50

The paper deals with a new rawin method which differs from those used earlier in that it permits measurement of both the mean wind speed and the turbulence parameters at various levels. The errors of the method are evaluated and a block diagram of the apparatus is described. Author

N66-23992# Teledyne, Inc., Alexandria, Va. UED Earth Sciences Div.
LONG-RANGE SEISMIC MEASUREMENT—CUP, 26 MARCH 1965 Seismic Data Laboratory Report No. 136
Don M. Clark 11 Feb. 1966 31 p
(Contract AF 33(657)-12447; ARPA Order 624; Proj. Vela Uniform)
(AD-629431) CFSTI: HC $3.60/MF $0.50

An analysis of seismological data from an underground nuclear explosion as a continuing study to provide information to aid in distinguishing between earthquakes and explosions. A table of travel-times and amplitudes of p, pg, lg, and surface waves are included along with other unidentified phases. Author (TAB)

N66-24099# Texas Instruments, Inc., Dallas. Science Services Div.
BASIC RESEARCH IN CRUSTAL STUDIES Final Report, 1 Sep. 1963–31 Dec. 1965
Stanley J. Laster and Milo M. Backus 31 Dec. 1965 396 p refs
(Contract AF 49(638)-1244; ARPA Order 292-63)
(AD-628385) CFSTI: HC $39.20/MF $1.75

The work falls into four tasks: (1) single-layer models; (2) multilayer models; (3) models with layer thickness variation; and (4) experimental studies using field data. The single-layer studies included theoretical investigation of normal and leaking modes, studies of the practical aspects of frequency-wavenumber analysis and investigation of mode separation by multichannel filtering. Theoretical and analog

model investigations for two layers over a half-space showed the difficulty in directly observing an intermediate velocity layer using frequencies of 0.5 cps or less. Analog model investigations of a model having a dipping M-discontinuity showed a wide range of phase velocities for ray events, as predicted. Experimental studies of field data showed the usefulness of velocity filtering as an interpretive aid. Correlation statistics for small events showed that only about 50 percent of the energy arriving between the first arrival and surface waves is predictable. For events at small distance (δ<30 km), Rayleigh-mode dispersion curves were measured. These suggested low near-surface velocities extending to a depth of 1/2-km. It was found that receiving arrays inline with the shot are necessary for adequate dispersion measurements. Author (TAB)

N66-24112*# California Univ., La Jolla. Dept. of Physics.
EFFECTS OF DIFFERENT FIELD EXPANSIONS ON OMNIDIRECTIONAL PROTON COUNTING RATE DATA
S. E. De Forest Dec. 1965 18 p refs
(Contract NASr-116)
(NASA-CR-74037) CFSTI: HC $1.00/MF $0.50 CSCL 04A

Investigations were conducted to determine the effects of improved expansions of the earth's magnetic field on data that have already been reduced using the previous 49 term expansion. The differences in the magnitude of the magnetic flux density, B, using the 49, and the more recent 64, and 100 term expansions are compared. At some locations, the percent difference is 2 to 3%. However, this does not give an indication of the effect of the field changes on the counting rate distribution in B-L space for charged particles. Three methods are presented for demonstrating these effects. It is stated that the first two approaches have the advantage of producing curves which show the expected changes as functions of positions, but they do not give any idea of the effect on the scatter of data from fitted curves; therefore, an actual data points analysis must be conducted. To compute the constants needed for the first two techniques, omnidirectional counting rates from Relay II were fitted to a least squares curve for several values of the magnetic parameter L. It is concluded that a significant reduction in the scatter of trapped particle data can be obtained by using the newer field representations. H.S.W.

N66-24115*# Stanford Univ., Calif. Radioscience Lab.
THERMAL BEHAVIOR OF THE IONOSPHERE AND OBSERVATIONS OF THE EXOSPHERE AND THE IONOSPHERE BY MEANS OF DISTANT EARTH SATELLITES Technical Report No. 2
A. V. da Rosa Dec. 1965 133 p refs
(Contract NASr-136)
(NASA-CR-74227; SEL-65-109) CFSTI: HC $4.00/MF $1.00 CSCL 04A

A theoretical study of the time dependent thermal behavior of the ionospheric electron gas was made. The conclusions from this study are discussed and evaluated. The results from the radio beacon experiment aboard the Eccentric Geophysical Observatory (EGO) satellite are also treated. Profiles of local electron concentration in the exosphere at heights between 6000 and 30,000 km were obtained. In addition, the examination of early morning data showed rearrangements in the ionized layer taking place between one half and one and one half hours after sunrise. An interpretation of this rearrangement is provided. A statistical investigation of the behavior of the nighttime columnar content of the ionosphere was also conducted. This investigation is based upon data obtained from Faraday rotation angle measurements using the 136 Mc telemetry carrier of the Syncom III satellite. The results of this investigation are analyzed. H.S.W.

N66-24231# Kyoto Univ. (Japan). Kyoto Univ. Library
CATALOGUE OF DATA IN THE WORLD DATA CENTER C2 FOR GEOMAGNETISM
Feb. 1966 80 p
CFSTI: HC $3.00/MF $0.75

This report includes lists of geomagnetic stations, the status of geomagnetic and earth current data collections, a bibliography, and some examples of magnetograms. N.E.N.

N66-24245# Uppsala Univ. (Sweden). Astronomical Observatory.
THE UPPSALA SPECTRAL CLASSIFICATION AND THE INTERSTELLAR ABSORPTION IN A REGION NEAR THE GALACTIC POLE
Bertil Ljunggren 1966 12 p refs Abstracts of Uppsala Dissertations in Sci. No. 66 *Its* Medd. No. 154
CFSTI: HC $1.00/MF $0.50

Contributions to the stellar classification are summarized. Among the findings reported are: relations between spectrophotometrically measured criteria and the stellar statistical quantities of absolute magnitude and intrinsic color; a modified luminosity classification of the late-type stars; the different inclinations in broad-band photometry of the reddening lines of different spectral classes; and interstellar absorption characteristics at high galactic latitudes. N.E.N.

N66-24316# Laboratoires du Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
MIGRATION OF RADIO ELEMENTS IN SOIL Final Report [MIGRATION DE RADIO-ELEMENTS DANS LE SOL Rapport Final]
L. Baetsle, W. F. Maes, J. Souffriau, and P. I. Staner Brussels, EURATOM, Mar. 1966 66 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-002-63-10 WASB)
(EUR-2481.f) CFSTI: HC $3.00/MF $0.50

The meteorological and hydrological observations taken at the Mol site were studied, and a correlation was established between both sets of data. From these data the recharge rate of the aquifer and the infiltration velocities were computed. A multicounter device was developed for the measurement of groundwater velocity and directing in nonconsolidated media. The apparatus is constructed of a stainless steel cylinder with four counter tubes piercing the bottom and one injection needle at the center of the bottom plate. The activity of the counters are recorded simultaneously to provide activity-time plots which characterize the movement. Dispersion phenomena studies showed the existence of two distinct dispersion mechanisms, both primarily influenced by molecular diffusion. The dispersion coefficients vary between 10^{-3} and 10^{-5} cm^2/sec for velocities ranging from 10^{-2} to 10^{-4} cm/sec. Two techniques were developed in order to increase soil retention capacity for strontium 90. One technique uses lignite treated with $K_4Fe(CN)_6+FeCl_3$, and the other consists of soil treatment with HF followed by $K_2H_2Sb_2O_7$. D.T.

N66-24317# Library of Congress, Washington, D. C. Aerospace Technology Div.
SELECTED STUDIES OF ATMOSPHERICS [ATMOSFERNOYE ELEKTRICHESTVO] Surveys of Soviet Scientific and Technical Literature

25 Feb. 1966 35 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 177, 1965 p 42–45, 55–65, 67 (ATD-66-21)

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2. RESULTS OF THE REGISTRATION OF THE WAVEFORMS OF NEAR ATMOSPHERICS B. K. In'kov p 7–11 ref (See N66-24319 13-13)

3. SOME RESULTS OF AN INVESTIGATION OF THE ATMOSPHERIC RADIO INTERFERENCE FIELD IN A WIDE FREQUENCY RANGE S. Ye. Oguryayev p 12–18 refs (See N66-24320 13-13)

4. AMPLITUDE-FREQUENCY AND PHASE CHARACTERISTICS OF VERY DISTANT ATMOSPHERICS S. I. Andreyeva and K. A. Yevteyeva p 19–22 refs (See N66-24321 13-13)

5. AMPLITUDE-FREQUENCY SPECTRA OF NEAR ATMOSPHERICS S. I. Andreyeva and K. A. Yevteyeva p 23–25 refs (See N66-24322 13-13)

N66-24318# Library of Congress, Washington, D. C. Aerospace Technology Div.

SOME CHARACTERISTIC FEATURES OF THE WAVEFORMS OF DISTANT ATMOSPHERICS [NEKOTORYYE OSOBENNOSTI FORM DAL'NIKH ATMOSFERIKOV]

B. K. In'kov *In its* Selected Studies of Atmospherics 25 Feb. 1966 p 1–6 refs (See N66-24317 13-13)

The dependence of atmospheric waveforms not only on the distance from the source but also on the direction of propagation is confirmed on the basis of an analysis of oscillograms. In the longitudinal direction, oscillations attenuate more sharply than they do in the latitudinal direction. The variation in the duration of consecutive quasi-half-periods as a function of distance is satisfactorily described by the given formula, which was derived from approximate calculation.

Author

N66-24319# Library of Congress, Washington, D. C. Aerospace Technology Div.

RESULTS OF THE REGISTRATION OF THE WAVEFORMS OF NEAR ATMOSPHERICS [REZUL'TATY REGISTRATSII FORM BLIZHNIKH ATMOSFERIKOV]

B. K. In'kov *In its* Selected Studies of Atmospherics 25 Feb. 1966 p 7–11 ref (See N66-24317 13-13)

On the basis of experimental data, the waveforms of near atmospherics are classified according to distance. It is noted that the waveform of an atmospheric becomes smoother as the distance from the source increases.

Author

N66-24320# Library of Congress, Washington, D. C. Aerospace Technology Div.

SOME RESULTS OF AN INVESTIGATION OF THE ATMOSPHERIC RADIO INTERFERENCE FIELD IN A WIDE FREQUENCY RANGE [NEKOTORYYE REZUL'TATY ISSLEDOVANIYA POLYA ATMOSFERNYKH RADIOPOMEKH V SHIROKOY POLOSE CHASTOT]

S. Ye. Oguryayev *In its* Selected Studies of Atmospherics 25 Feb. 1966 p 12–18 refs (See N66-24317 13-13)

The results of an investigation of the atmospheric radio interference field in the 1.5 to 16 kc range for the period March 1963–January 1964 are presented. The possibility is demonstrated of approximating the observed curves according to the relationship

$$P(E)=\left[1+\left(\frac{E}{E_{50}}\right)^{q}\right]^{-1}$$

Author

N66-24321# Library of Congress, Washington, D. C. Aerospace Technology Div.

AMPLITUDE-FREQUENCY AND PHASE CHARACTERISTICS OF VERY DISTANT ATMOSPHERICS [AMPLITUDNO-CHASTOTNYYE I FAZOVYYE KHARAKTERISTIKI SVERKHDAL'NIKH ATMOSFERIKOV]

S. I. Andreyeva and K. A. Yevteyeva *In its* Selected Studies of Atmospherics 25 Feb. 1966 p 17–22 refs (See N66-24317 13-13)

The results of a spectral analysis of atmospherics arriving from distances of 5000–6000 km are presented. Their amplitude-frequency and phase-frequency spectra are discussed.

Author

N66-24322# Library of Congress, Washington, D. C. Aerospace Technology Div.

AMPLITUDE-FREQUENCY SPECTRA OF NEAR ATMOSPHERICS [AMPLITUDNO-CHASTOTNYYYE SPEKTRY BLIZHNIKH ATMOSFERIKOV]

S. I. Andreyeva and K. A. Yevteyeva *In its* Selected Studies of Atmospherics 25 Feb. 1966 p 23–25 refs (See N66-24317 13-13)

An analysis of the spectral composition of atmospherics at distances of up to 150 km from their source is given. The atmospherics were registered by a network of direction-finding and atmospheric waveform recording stations in the Leningrad Oblast.

Author

N66-24340# Norwegian Meteorological Inst., Blindern.

ON EMPIRICAL DEDUCTION OF LAWS FROM GEOPHYSICAL RECORDS

Jack Nordo *In its* Statist.-Dynamical Meteorol. Predictions Nov. 1965 14 p refs (See N66-24334 13-20) CFSTI: HC $17.80/MF $1.00

The main topic of this paper is to explain some of the reasons why many empirical studies fail to give significant results. Instrumental errors as well as events on scales less than those to be considered, will e.g. cause systematic distortions of the empirically derived laws. Another kind of misinterpretation results from lack of proper knowledge of the limitations of various mathematical methods. Problems in interpreting results of harmonic analysis are specifically mentioned in this connection. Most standard procedures are rather inefficient in detecting even the simplest law within the given data sample. An attempt is made to present a method which has a higher capability of detecting possible optimal relations.

Author

N66-24393*# Aracon Geophysics Co., Concord, Mass.

THE FEASIBILITY OF SEA SURFACE TEMPERATURE DETERMINATION USING SATELLITE INFRARED DATA

James R. Greaves, Raymond Wexler, and Clinton J. Bowley Washington, NASA, May 1966 54 p refs (Contract NASw-1157) (NASA-CR-474) CFSTI: HC $3.00/MF $0.50 CSCL 08J

An investigation, based on actual infrared data, has been made of the feasibility of observing sea surface temperatures or temperature gradients from a satellite. It has been found that the satellite-measured large-scale patterns are generally persistent, with only limited day-to-day changes, and that the smaller scale features are similar to those observed in intensive conventional measurement programs over relatively restricted areas. A critical problem is the detection and elimination of data points where clouds prevent an uncontaminated view of the sea surface. It is found that, in daytime, the TIROS Channel 5 data, converted to an albedo, are suitable for detecting cloud contaminated points. Other sources of cloud cover information, such as conventional meteorological observations and satellite TV data, are insufficient for determining all the significant clear areas for satellite observations of sea surface temperature. This suggests that comprehensive studies or operational analyses of sea surface temperatures will require the processing of relatively extensive quantities of satellite radiation data, using these data themselves to determine the daytime cloud-free areas. A single case (for a period of six days) is analyzed using this approach, and strongly substantiates these conclusions. It is recommended that a more extensive set of pilot studies, using the approach of the processing of relatively extensive samples of data, be conducted. Author

N66-24459# Holman (John F.) and Co., Inc., Washington, D. C.

THE ACCURACY OF CONTINUOUS TRIANGULATION NETWORKS

K. L. Provorov Ft. Belvoir, Va., Army Engr. Res. and Develop. Labs., Feb. 1966 194 p refs Transl. into ENGLISH of the book "O Tochnosti Sploshnykh Setey Triangulyatsii" Moscow, Izd. Geod. Lit., 1956

(Contract DA-44-009-AMC-930(T))

(ERDL-T-1816-66; AD-627721) CFSTI: HC $5.00/MF $1.00

Accuracy of results of angle measurements in a continuous triangulation network; Errors in determining the lengths of sides and direction angles in a continuous triangulation network consisting of equilateral triangles; Evaluation of the accuracy of elements of a network consisting of triangles of an arbitrary form; Errors in determining the elements of diagonals in a continuous network consisting of equilateral triangles; Experimental studies for investigating the errors in a continuous triangulation network; Influence of the form of the figures on the accuracy of the elements of a continuous network; Accuracy of determination of third- and fourth-order triangulation stations; and Allowance for the influence of errors of initial data. TAB

N66-24480# Bureau of Mines, Washington, D. C.

WATER USE IN THE PETROLEUM AND NATURAL GAS INDUSTRIES

Paul M. Buttermore 1966 45 p refs

(BM-IC-8284) GPO: $0.30

As part of a national canvass of water use the Bureau of Mines compiled data on water requirements in the petroleum and natural gas industries for the calendar year 1962, specifically in well drilling, secondary-recovery operations, and natural gas processing plants. Total new water use in the petroleum industry of the United States, excluding refining, was 5.3 billion barrels. Secondary-recovery operations and natural gas processing plants required about 2.5 billion barrels of new water input; each of these requirements was about eight times greater than that for well drilling. Total use, including recirculated water, was 45.3 billion barrels of which 3.4 billion barrels was consumed. The greatest use of recirculated water was for natural gas processing, amounting to 38.2 billion barrels. Projections of total water use show that by 1975, 75.4 billion barrels will be used by the petroleum industry, of which 10.2 billion barrels will be new water. By 1985, the total use requirement will be 92.8 billion barrels, of which 13.1 billion barrels will be new water. Author

N66-24499*# Pennsylvania State Univ., University Park. Dept. of Geochemistry and Mineralogy.

STUDY OF STRUCTURAL AND MINERALOGICAL SIGNIFICANCE OF METEORITE IMPACT SITES, INCLUDING MINERAL PARAGENESIS, HIGH PRESSURE POLYMORPHS, MICROFRACTURES AND QUARTZ LAMELLAE Third Annual Report, Jan.–Dec. 1965

D. P. Gold, B. Robertson, F. K. Aitken, V. Vand, D. F. Tuttle, et al Jan. 1966 123 p refs *Its* Saimann. Rept.-5

(Grant NsG-473)

(NASA-CR-74563) CFSTI: HC $4.00/MF $0.75 CSCL 08G

Several studies are reported which deal with the formation of meteoritic craters and the structural changes at such impact sites. Analysis of the mesoscopic structures around the New Quebec crater were completed. The diagrams show an annular maximum on small circles of decreasing diameter, whose centers are offset from the vertical to the southeast, probably indicating a non-vertically directed explosion. Preliminary study on the triclinicity of the potash feldspars reveals no systematic variation with location about the New Quebec or Brent craters, and no coesite has been detected in any of the rocks. Microfractures in quartz from the Brent Crater are also discussed, and a search is reported for coesite and stishovite in rocks from varied geologic environments. A master's thesis, entitled Petrology of the Bedrock and Breccia Erratics in the Region of Lac Couture, Quebec, is appended. M.W.R.

N66-24549*# Geophysics Corp. of America, Bedford, Mass.

SODIUM VAPOR EXPERIMENT Quarterly Progress Report No. 2, 1 Oct.–31 Dec. 1965

Jan. 1966 31 p refs

(Contract NAS5-3970)

(NASA-CR-74582) CFSTI: HC $2.00/MF $0.50 CSCL 04A

Progress is reported on an upper atmospheric wind study using rocket laid vapor trails. The major effort during this period involved preparations for the firing of five Nike-Apache vapor payloads from Wallops Island. Included are discussions of the purpose and preparations for these firings, some aspects of the general atmospheric dynamics in the E-region, and a preliminary analysis of the irregular structure in vapor trails below about 105 km which has raised the question of pre-existing atmospheric turbulence. The vapor trail irregularities observed are not consistent with present theories of turbulence and are therefore not conclusive evidence of pre-existing turbulence in the atmosphere. There is some evidence to support the conclusion that the disturbance is in some way connected with the vapor trail formation. R.N.A.

N66-24569# Joint Publications Research Service, Washington, D. C.

ATMOSPHERIC DENSITY VARIATIONS AT HEIGHTS OF 25-80 KM

V. G. Kidiyarova *In its* Recent Develop. in Meteorology and Hydrol., 9 Mar. 1966 p 24-32 refs (See N66-24566 13-13)

CFSTI: $3.00

A detailed investigation was conducted on the variations of the mean values and variability of atmospheric density as a function of latitude and season. The study also attempted to detect atmospheric regions with a special behavior of density. The seasonal and latitude variations of the mean values and the variability of density were studied in the 25 to 80 km range in three latitude zones: tropical (0–30°N), temperate (30–60°N, and polar (60–90°N). As a result of poor coverage for the tropical zone, seasonal variations could be considered only in the polar and middle latitudes. In studying the seasonal and latitude variations of density in the 25 to 45 km range, it was concluded that there are layers in which these variations attenuate. These layers are situated in different latitude zones, and in different seasons at different heights, but in general they occupy regions near heights of 25, 50, and 70 km. Results were in good agreement with those of other investigators. R.N.A.

N66-24570# Joint Publications Research Service, Washington, D. C.
ANOMALIES OF HEAT BALANCE TERMS OF THE OCEAN
M. I. Budyko, R. L. Kagan, and L. A. Strokina *In its* Recent Develop. in Meteorology and Hydrol. 9 Mar. 1966 p 33–39 refs (See N66-24566 13-13) CFSTI: $3.00

New computations were made of the anomalies of the heat balance terms of the ocean based on observational data from 9 weather ships situated in the northern Atlantic Ocean between 35°N and 66°N and 2°E and 51°W for the period 1951–1960. The data were used to compute monthly values of the radiation balance, expenditures of heat on evaporation, and turbulent heat exchange. Monthly values were also determined for the change of heat content in the upper 100 m layer of water. Data on anomaly variations of the heat balance components in the North Atlantic show that in a number of cases these anomalies have considerable stability in space and time. This confirms the possibility of using information on the heat balance of the oceans in studying nonstationary atmospheric processes of a large scale and in developing methods for long range weather forecasts. R.N.A.

N66-24654# Hawaii Inst. of Geophysics, Honolulu.
[HAWAII INSTITUTE OF GEOPHYSICS RESUME OF WORK] Annual Report, 1964–1965
Jul. 1965 87 p refs

The institute facilities are described, including the new research yacht. During the year, five additional grants were received, three for the new vessel, for equipment for chemical and mineralogical composition studies, and for a cloud physics observatory. The administrative set-up and the scientific personnel are mentioned. Brief research reports are included for aeronomy, astrophysics and astronomy, geochemistry, geology, meteorology, oceanography, soil genesis, solid earth geophysics, and tsunamis. N.E.N.

N66-24660# Geophysics Corp. of America, Bedford, Mass.
CIRCULATION PROCESSES AND MIXING MECHANISMS IN THE UPPER ATMOSPHERE ABOVE 30 KM Final Report
Owen Cote Mar. 1965 142 p refs Prepared for Sandia Corp. (GCA-TR-65-4-G)

The factors effecting the fall speed and relative dispersion of small particles are considered. Terminal fall speeds, corrected for slip flow, and the total gravitational settling time from 70 to 30 km are computed. The influences of particle shape and orientation, of photophoresis, and of hydrodynamical interaction between the particles in a cloud on fall speed are reviewed and shown to be significant. Transport and dispersion processes effecting the cloud are assumed to be independent. The total gravitational settling time to 100,000 feet is taken to represent the time available for atmospheric dispersion. The relative dispersion of the particle cloud is calculated assuming a Gaussian cloud distribution. The magnitude of the effective eddy diffusion coefficient is based upon both observed radioactive debris dispersion and theoretical studies of atmospheric dispersion. Maximum particle concentrations to be expected at 100,000 feet are equated to particle concentrations at the center of the model cloud. The surface concentration is discussed in terms of the present model. Author

N66-24661# Defence Research Telecommunications Establishment, Ottawa (Ontario).
ALOUETTE 1, IONOSPHERIC DATA, ALOSYN, 16–28 FEBRUARY 1963
1 Feb. 1966 132 p

Topside sounder synoptic data from the Alouette I Satellite are presented. The selected ionospheric parameters were obtained from the ionograms, and are tabulated for all sounder data recorded during the month. N.E.N.

N66-24662# Defence Research Telecommunications Establishment, Ottawa (Ontario).
ALOUETTE I, IONOSPHERIC DATA, ALOSYN, 16–31 MARCH 1963
1 Mar. 1966 146 p For abstract see N66-24661 13-13

N66-24663# Defence Research Telecommunications Establishment, Ottawa (Ontario).
ALOUETTE I, IONOSPHERIC DATA ALOSYN, 1–15 FEBRUARY 1963
1 Feb. 1966 157 p For abstract see N66-24661 13-13

N66-24684# Esso Research and Engineering Co., Linden, N. J.
CARBON COMPOUNDS IN TERRESTRIAL SAMPLES AND THE ORGUEIL METEORITE
W. G. Meinschein [1964] 31 p refs

Meteorites contain extraterrestrial carbonaceous materials. The Alais, Orgueil, Tonk, and Ivuna meteorites resemble in their carbon, free sulfur, and non-metamorphosed mineral contents, densities, and general appearances certain organic-rich terrestrial sediments. Structural and isotopic determinations of carbon compounds in the Orgueil chondrite indicate that these compounds are primarily indigenous. Benzene extractable carbonaceous materials from Orgueil fragments and terrestrial sediments have similar chromatographic properties. Infrared and ultraviolet spectra show that they contain compounds of the same functional types. Mass spectrometric analyses of the alkanes from the Orgueil meteorite, sediments, and organisms are statistically indistinguishable at the 95 percent confidence level. Theoretical considerations and experimental data are presented which support the view that alkanes are well constituted to serve as indicators of former life. Author

N66-24686*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OBSERVATIONS ON PULSATING AURORAS

G. R. Cresswell (Alaska Univ.) and T. N. Davis Nov. 1965 22 p refs Prepared in part at Alaska Univ.
(Contract NAS5-9065)
(NASA-TM-X-55445; X-612-65-485) CFSTI: HC $1.00/MF $0.50 CSCL 04A

Observations on pulsating auroras occurring near the equator side of the boundary of auroral displays during their post-breakup phase have been made with an image orthicon television system and with photometers. It is found that the pulsating phase of the display is composed of numerous relatively short sequences of pulsations which are restricted to small field-aligned volumes. The luminosity varies synchronously within a given auroral form but adjacent forms may pulsate asynchronously. Author

N66-24689*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TERRAIN PHOTOGRAPHY ON THE GEMINI IV MISSION Preliminary Report
Paul D. Lowman, Jr., James A. Mc Divitt, and Edward H. White Feb. 1966 26 p refs
(NASA-TM-X-55456; X-641-66-52) CFSTI: HC $2.00/MF $0.50 CSCL 08F

During the 4-day Gemini IV flight in June, 1965, about 100 color pictures of land areas were taken with a 70 mm hand-held camera for geologic and geographic study, as part of the synoptic terrain photography experiment. This paper presents a brief summary of the objectives, methods, and results of the experiment. Representative pictures of the southwest United States, northern Mexico, and portions of Africa and the Arabian peninsula are presented and described. Preliminary study indicates that these pictures will be useful in studying regional structure, revising small scale geologic maps, and searching for and studying impact structures. Author

N66-24786# Florida State Univ., Tallahassee. Dept. of Statistics.
SOME NONPARAMETRIC BAYESIAN ESTIMATION PROBLEMS
K. M. Lal Saxena Oct. 1965 70 p refs
(Contract Nonr-988(13))
(M100; AD-623834) CFSTI: HC $3.00/MF $0.75

Two sample nonparametric decision problems for single parameter families of distributions are considered from the Bayesian viewpoint when only the relative magnitudes of the observation are known for the paired comparison data, the rank order data and the signed rank order data. The term nonparametric is used as the decision procedures depend on nonparametric statistics. It is assumed that the likelihood functions for the three kinds of data depend on the parameters of the sampled populations through some function H. A prior distribution is considered for the random variable H. The problem of the Bayes estimation of H, with the squared error loss function, is considered for the three kinds of data. A number of analytic properties of the posterior distribution of H and the orderings of the values of the Bayes estimate of H are obtained. Examples are given from a normal and a uniform family of distributions. Sufficient conditions are given on the sampled populations for the risk of the Bayes estimate of H to go to zero as the sample sizes go to infinity for the three kinds of data. The Bayes two decision problem, the two decisions being $H>h$ and $H\leq h$, with the (0,1) loss function, is considered for the paired comparison data and the rank order data. Monotonic properties of the Bayes decision procedures are obtained under mild conditions on the sampled populations. Sufficient conditions on the sampled populations are given for the risk of the Bayes two decision procedures to go to zero as the sample sizes go to infinity. Author (TAB)

N66-24805# Genoa Univ. (Italy). Instituto Geofisico e Geodetico.
UPPER ATMOSPHERE VLF SOURCE (ON WHISTLERS AND VLF EMISSIONS RECORDED AT ROBURENT, NORTH ITALY) Final Report
M. Bossolasco, A. Caneva, G. Cicconi, I. Dagnino, and A. Elena Oct. 1965 4 p refs
(Contract AF 61(052)-591)
(AFCRL-66-39; AD-628809) CFSTI: HC $1.10/MF $0.50

For several months whistlers and vlf emissions are recorded at Roburent (North Italy) with an appropriated instrumentation. The preliminary results thereby obtained are presented and discussed. For some characteristics of the whistling atmospherics there is a good agreement with the results found at Durban, South Africa (not too far from the conjugate point of Roburent). Author (TAB)

N66-24822# Oslo Univ., Blindern (Norway). Inst. of Cosmic Physics.
ELF AND VLF EMISSIONS IN NORTHERN SCANDANAVIA Summary Report No. 1
Alv Egeland 20 Aug. 1965 25 p refs
(Contract AF 61(052)-811)
(AFCRL-66-9; AD-628281) CFSTI: HC $2.60/MF $0.50

In this report, the frequency band of naturally-occurring electromagnetic emissions between DC and 10 kc/s is divided into three sub-bands, namely: the band between DC and, say 6 cps, where the micropulsations are most pronounced, the earth–ionosphere cavity resonance band between 6 and 40 cps, and finally one broad spectrum between 40 cps and 10 kc/s, where both propagation and emissions phenomena are important. Both the equipment, the method of recording and analyzing, as well as the preliminary results obtained within these three bands are discussed in Sections 2 to 4. Construction and building of new receiving equipment (amplifiers, filters, spectrum analyzers etc.) has taken very much time. Data have already been gathered. In Section 5 the research plans for the next year are described. Author (TAB)

N66-24831*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
STATIC DIFFUSION MODELS OF THE UPPER ATMOSPHERE WITH EMPIRICAL TEMPERATURE PROFILES
Luigi G. Jacchia 1965 50 p refs *Its* Contrib. to Astrophys., Vol. 8, No. 9
(Grant NsG-87-60)
(NASA-CR-74820) CFSTI: HC $2.00/MF $0.50 CSCL 04A

Tables of atmospheric density and composition are computed for a wide range of exospheric temperatures starting from a fixed set of boundary conditions at 120 km. The diffusion equation is integrated following empirical temperature profiles of exponential form capable of reproducing the densities derived from satellite drag over the years. Formulae are given which relate the exospheric temperature to solar and geomagnetic activity and allow for the diurnal and semiannual variations. The different response of the density at the 200 km level to different types of heating is briefly discussed. Author

N66-24845# Air Force Dept., Washington, D. C.
ARCTIC AND SUBARCTIC CONSTRUCTION. CALCULATION METHODS FOR DETERMINATION OF DEPTHS OF FREEZE AND THAW IN SOILS
5 Jan. 1966 98 p refs Prepared jointly with AF Dept. Supersedes TM-5-852-6, Oct. 1954
(TM-5-852-6; AFM-88-19, CH. 6)

This manual contains criteria and methods for calculating the depth of freeze and thaw in soils, with consideration of the effects of other adjacent materials, for the design and construction of military facilities in arctic, subarctic, and seasonal frost areas. Author

N66-24855# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
BIBLIOGRAPHY ON SOIL DYNAMICS
R. K. Bernhard Sep. 1965 127 p refs
(CRREL-SR-89; AD-477379)

The scientific approach to a study of soils as an indispensable engineering material is rather new, and its subdivision into soil statics and soil dynamics is of still newer origin. In attempting to answer the question, 'Why soil dynamics' it might be useful to recall the history of testing materials other than soil. The study of steel specimens subjected to slowly increasing static loads was followed by the introduction of vibratory or dynamic loads, which led to the discovery of fatigue effects. A cross-fertilization of both methods took place, contributing to a new concept in instrumentation and recently expanding into the field of solid-state physics. Similarly, the investigation of soil dynamics will feed information back into soil statics and result in a better understanding of both areas from the practicing engineer's point of view, the impetus to study soil dynamics is due mainly to the increased speeds and loads of present-day vehicles affecting subsoils, the practice of dynamic precompaction of subsoils, and the discrimination between subsurface exposions (nuclear) and earthquakes. TAB

N66-24859# Naval Weapons Lab., Dahlgren, Va. Computation and Analysis Lab.
SENSITIVITY TO GEOID HEIGHTS DETERMINED FROM SATELLITE OBSERVATIONS TO DISTRIBUTION OF TRACKING STATIONS
Carolyn P. Crawley Jan. 1966 19 p refs
(K-2/66; AD-478198)

Sensitivity of geodetic solutions to various amounts of data is discussed. It is demonstrated that solutions are greatly affected by a large reduction in data, but that a remarkable degree of recovery can be obtained by increasing the amount of data or by removing the biases due to resonance parameters. Author (TAB)

N66-24876# Defence Research Board, Ottawa (Ontario). Directorate of Scientific Information Services.
STRUCTURE OF SEA ICE OF GREAT THICKNESS
N. V. Cherepanov Jan. 1966 13 p refs Transl. into ENGLISH from Tr. Arkticheskogo i Antarkt. Nauchno-Issled. Inst. (Leningrad), v 267, 1964 p 13-18
(T-448-R) CFSTI: HC $1.00/MF $0.50

This report describes the petrographic studies conducted on ice island SP-6 in 1958. The studies yielded data on the structure of sea ice growing under natural conditions to a thickness of 10 to 12 meters. The special conditions under which these ice masses exist, conditions related to their lengthy period of accretion, have resulted in the formation of sea ice which in its structure and properties is sharply distinct from all other types of ice encountered in the Arctic. Some of the strong distinguishing features of the SP-6 ice island were its crystalline structure with crystals uniform in shape and orientation, a unique distribution of inclusions, and a particular salinity and density. R.N.A.

N66-24886# Royal Aircraft Establishment, Farnborough (England).
PERTURBATIONS OF NEAR-CIRCULAR ORBITS BY THE EARTH'S GRAVITATIONAL POTENTIAL
G. E. Cook Nov. 1965 24 p refs
(RAE-TR-65252) CFSTI: HC $1.00/MF $0.50

The behavior of near-circular orbits in the Earth's gravitational potential is discussed in detail. The major axis rotates at a nonuniform rate or oscillates about a position of equilibirum depending on the initial conditions. Author

N66-24953*# Stanford Univ., Calif. Radioscience Lab.
LUNAR RADAR MEASUREMENTS OF THE DIURNAL EXCHANGE OF IONIZATION BETWEEN THE IONOSPHERE AND THE MAGNETOSPHERE Scientific Report No. 14
Philip Yoh Dec. 1965 27 p refs
(Grant NsG-377)
(NASA-CR-74781; SEL-65-103) CFSTI: HC $2.00/MF $0.50 CSCL 04A

During the period from December 1963 to April 1964 a large number of simultaneous measurements of the Faraday polarization rotation and the Doppler excess frequency of radar echoes were made at Stanford, California. The experimental results showed a large temporal variation of the electron content above the earth's ionosphere. This variation of the electron content is attributed to an exchange of ionization between the ionosphere and the lower magnetosphere. A net upward electron flux of about $3.7 \times 10^{12}\ m^{-2}\ sec^{-1}$ is found in the morning; the corresponding number for downward flow in the afternoon is about $2.8 \times 10^{12} m^{-2} sec^{-1}$. If a diffusive-equilibrium model is assumed, it can be demonstrated that the cause of this flow is the change of temperature in the region of the upper ionosphere and lower magnetosphere. Author

N66-24969*# New York Univ., N. Y. Chemistry Dept.
THEORETICAL STUDY OF ATOMIC AND MOLECULAR GASES AND THEIR REACTIONS IN THE UPPER ATMOSPHERE Semiannual Report, Nov. 1, 1965-Apr. 30, 1966
R. C. Sahni [1966] 13 p refs
(Grant NsG-76-60)
(NASA-CR-74684) CFSTI: HC $1.00/MF $0.50 CSCL 04A

Research conducted in the theoretical study of atomic and molecular gases is summarized. Abstracts of research reports in the following specific areas are included: calculation of the potential energy (PE) curve and molecular constants of the ground state of the CO molecule using Slater screening constants as well as best linear combination of atomic orbitals (LCAO) molecular orbitals (MO) with 1s, 2s, and 2p functions; calculation of the PE curves and molecular constants of the ionized states of the CO molecule using best LCAO MO's with 1s, 2s and 2p functions; calculation of the PE curve and molecular constants of the ground state of the N_2 molecule using the extended set of functions; and development of semi-empirical procedures such as Rydberg-Klein-Rees method to calculate PE curves, molecular constants, transition probabilities of different band systems, and electric and magnetic susceptibilities of diatomic molecules. H.S.W.

N66-24994*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

STATIC DIFFUSION MODELS OF THE UPPER ATMOSPHERE WITH EMPIRICAL TEMPERATURE PROFILES

Luigi G. Jacchia Washington, 1965 53 p refs *Its* Contrib. to Astrophys., Vol. 8, No. 9

(Grant NsG-87-60)

(NASA-CR-74721) GPO: HC $0.40; CFSTI: MF $0.50 CSCL 04A

Tables of atmospheric density and composition are computed for a wide range of exospheric temperatures, starting from a fixed set of boundary conditions at 120 km. The diffusion equation is integrated following empirical temperature profiles of exponential form capable of reproducing the densities derived from satellite drag over the years. Formulae are given which relate the exospheric temperature to solar and geomagnetic activity and allow for the diurnal and semi-annual variations. The different response of the density at the 200 km level to different types of heating is briefly discussed. Author

N66-25025*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.

ABUNDANCES OF Na, Sc, Cr, Mn, Fe, Co, AND Cu IN CHONDRULES; Na, Mn, AND Cu IN METEORITES; AND In IN METEORITIC AND TERRESTRIAL MATTER Quarterly Progress Report, 1 Dec. 1965–28 Feb. 1966

R. A. Schmitt 28 Feb. 1966 20 p refs

(Contract NASw-843)

(NASA-CR-74881; GA-6999) CFSTI: HC $1.00/MF $0.50 CSCL 08D

Abundances of elements were determined by instrumental neutron activation analysis in chondrules and trolites pieces and in meteorites. The tabulated data are given. A study of In abundances for carbonaceous chondrites was made, and some specimens analyzed in earlier experiments were reexamined. It is suggested that In behaves quite differently from the other trace elements in that it has been severely depleted in ordinary chondrites. It is proposed that a systematic study of In over the entire meteoritic and terrestrial spectra should be undertaken. N.E.N.

N66-25026# Naval Research Lab., Washington, D. C. Physical Chemistry Branch.

ATMOSPHERIC RADIOACTIVITY IN ANTARCTICA, 1956–1963

L. B. Lockhart, Jr., R. L. Patterson, Jr., and A. W. Saunders, Jr. 3 Nov. 1965 18 p refs

(Contract AT(49-7)-2435)

(NRL-6341) CFSTI: HC $1.00/MF $0.50

Continuous measurements of the radioactive aerosol content of the surface air in Antarctica have been made since 1956 first at Little America and later at the Amundsen-Scott South Pole Station. Both the radioactivity due to bomb-produced fission products and to the naturally occurring radio nuclides of the radon and thoron series were measured in daily collections; composite samples covering three-month periods were subjected to radiochemical analysis for such long-lived radionuclides as ^{90}Sr, ^{137}Cs, ^{144}Ce, ^{147}Pm, and ^{210}Pb. The observed natural radioactivity was lower in Antarctica than at any other geographical location, as might be expected from the absence of any quantity of exposed land surface in the vicinity. The fission-product concentrations, however, were equal to or greater than those observed in the southernmost parts of South America. Well-defined seasonal variations in airborne radioactivity were noted, with maxima in the summer. Author (NSA)

N66-25182# Joint Publications Research Service, Washington, D. C.

DISPERSION OF RADIOACTIVE AEROSOLS IN THE STRATOSPHERE

Ya. I. Gaziyev and L. Ye. Nazarov 1 Apr. 1966 14 p Transl. into ENGLISH from Radioaktivnyye Izotopy v Atmosfere i Ikh Ispol'zovaniye v Meteorologii (Moscow), 1965 p 181–185

(JPRS-34860; TT-66-31298) CFSTI: $1.00

This paper discusses the results of an investigation conducted to determine the dispersion of radioactive aerosols in the stratosphere from nuclear explosions in the central European part of the U.S.S.R. The radioactive aerosols were investigated using a stratospheric electrical precipitator and a high altitude filtering apparatus. These aerosol collectors were carried aloft by balloons. Samples were taken at heights of 19 to 21 km 2 to 3 years after the nuclear tests so that there was no significant radioactivity associated with very small particles which strongly coagulate with particles of the natural aerosols of the Junge layer, or very large particles which fall out rapidly. In the considered range of particle sizes there is an unambiguous dependence of the efficiency of electrical precipitation on particle size. This efficiency dependence is used for evaluating the dispersion of radioactive aerosols. Data are given showing the ratio of activities of Ce^{144} and Cs^{137} in the samples taken. R.N.A.

N66-25192# Joint Publications Research Service, Washington, D. C.

SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 131

2 May 1966 70 p refs Transl. into ENGLISH from Russian (JPRS-35295; TT-61-11147-131) CFSTI: $3.00

A compilation of abstracts, summaries, and full translations of articles on astronomy, meteorology, oceanography, terrestrial geophysics, and upper atmosphere and space research is presented. Complete bibliographic information accompanies each article. C.T.C.

N66-25258# Joint Publications Research Service, Washington, D. C.

LONG-PERIOD RHYTHMIC PHENOMENA IN THE ACTIVITY OF THE GULF STREAM

N. P. Smirnov 9 May 1966 21 p refs Transl. into ENGLISH from Izv. Vsesoyuznogo Geogr. Obshch (Leningrad), no. 5, Sep.–Oct. 1965 p 427–437

(JPRS-35408; TT-66-31844) CFSTI: $1.00

A determination was made of the long period rhythmic phenomena in the activity of the gulf stream. This was conducted in order to prepare an accurate long range forecast of the climatic conditions in the European part of the USSR, to give long range forecasts of hydrological conditions, and to correctly plan the future of fishing conditions. A water temperature index in conjunction with a periodogram analysis method was used, and the results are given in tabular form. Conclusions are that the temperature of the surface water of the North Atlantic in general has a rhythmic structure of variations. Eleven and nineteen year variations are manifested most constantly and clearly. In addition, in most regions there are variations with mean periods of about 7 and 4 years. C.T.C.

N66-25260# Oklahoma Univ. Research Inst., Norman. Atmospheric Research Lab.

THE DYNAMIC ASPECTS OF HURRICANE DORA, 1964

Clarence A. B. Warfel Feb. 1966 74 p refs
(Grant NSF G-172)
(ARL-1470-2)

The equations developed by Riehl for a steady, symmetrical hurricane model are used to estimate the structure of hurricane "Dora" (1964). In so doing a two-layer model of inflow and outflow is utilized. In the inflow it is assumed that potential vorticity is conserved. Whereas, in the outflowing mass, the conservation of the absolute angular momentum about the vertical axis at the center of the hurricane is assumed. These assumptions lead to the determination of the distribution of momentum transport across the air–ocean interface and, consequently, the radial profile of the tangential wind (when the outer boundary conditions have been specified). For each layer the maximum tangential wind (at the inner boundary) is determined from the kinetic energy equation for steady, frictionless flow as developed by Riehl. Next the maximum tangential wind is determined from the radial temperature distribution. Further, the mass circulation and radial motion are estimated. Finally, all the parameters which have been calculated are compared with the results of previous authors for other hurricanes in order to estimate the severity of hurricane "Dora". Author

N66-25266# Hawaii Inst. of Geophysics, Honolulu.
SOURCE MECHANISM STUDY OF THE ALASKA EARTHQUAKE AND TSUNAMI OF 27 MARCH 1964. PART I: WATER WAVES. PART II: ANALYSIS OF RAYLEIGH WAVE
George Pararas-Carayannis and Augustine S. Furumoto Dec. 1965 48 p refs
(Contract Nonr-3748(03); Grant NsF GF-153)
(HIG-65-17; AD-629857) CFSTI: HC $2.00/MF $0.50

The geologic history and a short description of the general geomorphology of the area affected by the 27 March 1964 Alaska earthquake are given. The extent of crustal displacement and the limits of the areas of subsidence and uplift as revealed by geologic evidence are discussed, as well as the method by which the tsunami-generating area was determined. The dimensions of this tsunami-generating area, its volume of crustal displacement, and the energy associated with the tsunami are calculated. There follows a short discussion on wave activity within and outside the generating area, and the possible generating mechanisms for the tsunami. Included as an appendix are two wave refraction diagrams of the Alaska tsunami drawn for the north Pacific Ocean area. The source mechanism of the Alaska Earthquake of 27 March 1964 was investigated by analyzing the Rayleigh wave recorded on the strain seismograph at Kipapa Station, Hawaii. The parameters that gave the best fit to the observed data were: rupture length of 800 km, rupture velocity of 3 km/sec, and direction of rupture line of S30°W. The results of this analysis compared favorably with field data of elevation changes, with distribution of epicenters of aftershocks, and with the area of generation of the tsunami as obtained from sea wave refraction diagrams. Author (TAB)

N66-25273# Stanford Research Inst., Menlo Park, Calif.
PENETRATION STUDIES OF ICE WITH APPLICATION TO ARCTIC AND SUBARCTIC WARFARE *Final Report, 17 May–1 Nov. 1965*
Bernard Ross Nov. 1965 52 p refs
(Contract Nonr-2332(00))
(AD-630122) CFSTI: HC $4.60/MF $0.50

Impact tests were made on floating ice slabs with particular attention devoted to the mechanism of penetration. The range of values investigated for the basic parameters was: impact velocity, 8 ft/sec–21 ft/sec; projectile mass, 4.56 lb–5.22 lb and penetrator diameter, 5/16 in.–1-1/4 in. The perforation of ice slabs made from seawater, and at approximately +17F (warm sea ice) is accompanied by the ejection of a shear plug from the test slab, whereas fresh water ice slabs under similar loading conditions fracture into segments along well defined radial cleavage planes. The experiments indicate that a blunt end penetrator profile is significantly more effective in the perforation of warm sea ice than a corresponding penetrator with conical profile. In addition, the order of magnitude of the impact velocity and temperature of the ice slab are important factors that can govern the mechanism of penetration. A simple mathematical model for shear plug ejection, based upon the laws of conservation of linear momentum and mechanical energy, provides correlation between a potential energy quantity containing projectile mass and release height, and a geometric quantity containing penetrator diameter and sea ice thickness. Using these quantities, curves are presented which indicate a threshold-of-perforation boundary for the warm sea ice. Finally, recommendations are made for guiding future investigations in this problem area. Author (TAB)

N66-25277# Joint Publications Research Service, Washington, D. C.
PROGRAM OF ACTIVITIES UNDER THE INTERNATIONAL HYDROLOGICAL DECADE IN THE SOVIET UNION (1965)
5 May 1966 82 p refs Transl. into ENGLISH from the booklet "Programma Rabot po Mezhdunarodnomu Gidrologicheskomu Desyatiletiyu v Sovetskom Soyuze" Moscow, 1965 p 5–69
(JPRS-35356; TT-66-31792) CFSTI: $3.00

The program of proposed research and activities in conjunction with the International Hydrological Decade is presented. The water resources and in the Soviet Union and the hydroelectric power stations are briefly described. The station locations and the equipment for measuring the precipitation and evaporation are listed. The program for water balance investigations is given. The scientific research proposed, with the expected results, is outlined, and includes erosion studies, hydrological forecasting, water quality studies, and man's influence on hydrological phenomena. The education and training of personnel, and the proposals for the exchange of data are discussed. N.E.N.

N66-25364# Atomic Energy Commission, New York. Health and Safety Lab.
CARBON-14 MEASUREMENTS IN THE ATMOSPHERE
1 Jan. 1966 81 p refs
(HASL-166) CFSTI: HC $2.50/MF $0.75

Data on atmospheric ^{14}C measurements are tabulated. Most of the data pertain to aircraft observations but a few deal with balloon-borne sampling and ground level collections. The Defense Atomic Support Agency Star Dust Program and some earlier data from a United Kingdom program are included. NSA

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N66-23910# David Sarnoff Research Center, Princeton, N. J.
AN ANALYSIS OF FACTORS LIMITING SEISMIC DETECTOR SENSITIVITY Final Report, 16 Oct. 1964–15 Jan. 1966
Donald S. Mc Coy 28 Feb. 1966 122 p refs
(Contract AF 49(638)-1456; ARPA Order 292)
(AFOSR-66-0494; AD-628933) CFSTI: HC $4.00/MF $0.75

A detailed analysis is presented to show the effect of certain design parameters on the signal-to-noise ratios of systems in which seismometers are coupled to galvanometer amplifiers. General guidelines are presented for optimizing the signal-to-noise ratio of such systems. The effect of feedback on the signal-to-noise ratio of seismic detector systems is analyzed. It is shown that if the amplifier input resistance is much higher than the required external damping resistance for a given seismometer transducer, the use of feedback to reduce the amplifier input resistance provides better signal-to-noise ratio than the use of a shunt resistance at the amplifier input terminals. It is also shown that feedback should not be used to increase the amplifier input resistance in order to provide proper damping. The potential advantage of displacement transducers over velocity transducers at lower frequencies is discussed. It is contended that the displacement transducer can have no advantage at frequency for which the sensitivity of the velocity transducer system is limited by the thermal noise of the amplifier input resistance. The lowest useful frequency for the velocity transducer system is determined in practice by the l/f noise of the amplifier. The sensitivity of clusters of seismometers connected to a single amplifier is summarized briefly and noise measurements on the Texas Instruments RA-3 Parametric Amplifier are presented.
Author (TAB)

N66-23937*# Army Engineer Geodesy, Intelligence and Mapping Research and Development Agency, Fort Belvoir, Va.
TWO APPROACHES TO A PORTABLE COLOR-MEASURING SYSTEM
Kenneth D. Robertson Jan. 1966 25 p refs
(NASA Order R-47-009-02)
(NASA-CR-74694; GIMRADA-RN-15; AD-629704) CFSTI: HC $1.00/MF $0.50 CSCL 20F

Two approaches to color measurement are presented, the spectrophotometer and the reflectometer. Descriptions are given of two portable instruments, one of each type. The first instrument was built using a flashlight lamp as light source a wedge interference filter as monochrometer, and a cadmium sulphide photoresistor as a detector. The second instrument was built with three filters which provided the tristimulus curves of the CIE standard observer, a flashlight lamp, and three barrier layer cells as detectors.
Author (TAB)

N66-23961# Johnson Service Co., Milwaukee, Wis. Research Div.
LOW PRESSURE SIGNAL SENSOR AMPLIFIER AND ANALOG COMPUTER USING THE IMPACT MODULATOR AS THE BASIC ACTIVE PURE FLUID DEVICE. PART II: LOW PRESSURE SIGNAL SENSOR AMPLIFIER Final Report, 1 Oct. 1964–30 Sep. 1965
Thomas J. Lechner 15 Dec. 1965 8 p
(Contract DA-49-186-AMC-126(D))
(AD-629056) CFSTI: HC $1.00/MF $0.50

The purpose of the investigation was to design an amplifier capable of sensing the output of a vortex rate sensor. The differential output of this rate sensor has two serious limitations; first the differential output change is small per degree of rate change, and second the sensor has a very high output impedance. An amplifier was constructed and bench tested with the sensor where feasibility was shown. The amplifier had high input impedance and sufficient gain but due to the small signal changes, the signal to noise ratio was poor. This work did point out the importance of proper impedance matching in fluidic devices, and suggested a new design concept for the amplifier.
Author

N66-23969# Naval Radiological Defense Lab., San Francisco, Calif.
DESIGN CRITERIA FOR WIDE RANGE GAMMA RADIACS USING SEMICONDUCTOR DIODE DETECTORS
Edward J. Wesley and Walter F. Joseph 8 Feb. 1966 35 p refs
(USNRDL-TR-975; AD-629511) CFSTI: HC $2.00/MF $0.50

The report covers the application of silicon semiconductor detectors to a wide-range, gamma-ray doserate meter using the detectors in a pulse counting mode. It reviews pertinent circuit and detector characteristics that establish the doserate ranges that can be covered, the energy dependence to be expected from both large lithium-drifted detectors and very small silicon junction diodes, and finally the stability requirements imposed on the electronics by the pulse mode of operation. Methods of tailoring the photon energy response of semiconductor detectors are reviewed. Particular attention is given to the effect on design of amplifier and detector noise and variations in the noise level. One example of a combination of detectors to cover the doserate range from 0.2 mR/h to 2000 R/h is shown. The report supports the conclusion that it is practical to make a survey meter, using silicon semiconductor detectors, that covers both the health physics and high doserate ranges of interest in military radiac design.
Author

N66-24214# Western Radiation Lab., Los Angeles, Calif.
AMERICIUM-241 AS A NONDESTRUCTIVE TESTING TOOL FOR THE AIRCRAFT AND SPACE INDUSTRY
Gordon Locher *In* ORNL Proc. of Symp. on Low-Energy X-ray Sources and Gamma Sources and Appl. Nov. 1965 p 124–137 (See N66-24206 13-24) CFSTI: HC $4.00/MF $1.75

Panoramic radiography was carried out at source-film distances as low as 1/8 in., using a long, thin ^{241}Am gamma source, inside steel tubes up to 0.100 in. thick. Penetrameter sensitivity of 2% and unsharpness values as low as 0.002 in. were obtained. There was no geometrical distortion of radiographs. A special exposure device was developed to do this work. It somewhat resembles a circular Potter–Bucky diaphragm surrounding the line source of gamma rays. Double-wall radiography was carried out on small tubing at source-film distance of 1.5 to 2.0 in. in another crowded component application, using devices resembling a fountain pen 3/8 in. OD in size and shape. ^{241}Am sources used ranged from 20 (1 mm focal spot) to 50 (1.5 mm) to 150 mC (2.0 mm). Simultaneous use of many units is expected, to speed radiographic output. Transmission type thickness gages were used with ^{241}Am sources up to 100 mC to gage steel up to 0.100 in. thick with a sensitivity of 0.0001 in. These replace high-energy beta sources formerly used. Applied to measurement of concentricity of seamless tubing, uniformity of wall thickness, and a host of other problems in military and aerospace industries, they proved their worth for special and for routine inspections.
Author (NSA)

N66-24216# Texas Nuclear Corp., Austin.
PRELIMINARY RESULTS OF X-RAY FLUORESCENCE ANALYSIS IN THE ENERGY RANGE 1 TO 5 KEV

Troy C. Martin, Kenneth R. Blake, and Ira L. Morgan *In* ORNL Proc. of Symp. on Low-Energy X-ray Sources and Gamma Sources and Appl. Nov. 1965 p 138–153 (See N66-24206 13-24) CFSTI: HC $4.00/MF $1.75

A gas proportional counter was constructed with a thin Be window, which is able to detect the K X-rays of elements down to and including the F K-α X-ray (0.677 keV). Preliminary data were obtained for Mg (1.254 keV) and Si (1.74 keV) in an Fe_2O_3 matrix. Errors due to matrix or interelement effects are shown. The source used was a Ti–^{3}H preparation. Fluorescent excitation of Ti, NaCl, Si, Al, and Mg were compared in an air and helium atmosphere. The effect of air absorption was clearly demonstrated. Fluorescent spectra of nickel, of fluorine in teflon, and of calcium and silicon in ocean core samples are given. Data are presented in tables and graphs.
NSA

N66-24216# Argonne National Lab., Ill.
DEVELOPMENTS IN A PORTABLE X-RAY FLUORESCENCE INSTRUMENT USING RADIOISOTOPE EXCITATION SOURCES
John O. Karttunen and Dale J. Henderson *In* ORNL Proc. of Symp. on Low-Energy X-ray Sources and Gamma Sources and Appl. Nov. 1965 p 154–181 refs (See N66-24206 13-24) CFSTI: HC $4.00/MF $1.75

The radioisotope ^{147}Pm in an aluminum matrix and emitting bremsstrahlung was found to be a more universal excitation source for fluorescence X-rays of elements in the Z range 19 through 92 than titrated Zr. The quantitative analysis of binary, ternary, and quaternary mixtures is illustrated. The apparatus is miniaturized, has a total weight of 11 lb, and can be contained in a volume of less than 1 ft^3. This project was originally undertaken to develop a portable X-ray fluorescence instrument for various uses. Because of its relatively low cost, compactness, versatility, and simplicity, the apparatus developed has merit as a possible lunar probe and as a geological field instrument, as well as in other applications.
NSA

N66-24220# IIT Research Inst., Chicago, Ill.
ROUND TABLE DISCUSSION [LOW-ENERGY X-RAY SOURCES AND GAMMA SOURCES AND APPLICATIONS]
L. Reiffel et al *In* ORNL Proc. of Symp. on Low-Energy X-ray Sources and Gamma Sources and Appl. Nov. 1965 p 231–238 (See N66-24206 13-24) CFSTI: HC $4.00/MF $1.75

Radioactive isotope technology, development of isotopes as X-ray and gamma ray emitters, and their applications to medical radiography and industrial uses were discussed. Portable devices, solid state detectors, scintillation counters, and X-ray fluorescence analysis were mentioned. Emphasis was placed on the lack of complete information on radioisotopes technology and the need for extending the present state-of-the-art.
N.E.N.

N66-24226# Washington Univ., St. Louis, Mo. Edward Mallinckrodt Inst. of Radiology.
AN IMAGE TUBE SCINTILLATION CAMERA
Michel M. Ter-Pogossian *In* ORNL Proc. of Symp on Low-Energy X-ray Sources and Gamma Sources and Appl. Nov. 1965 p 295–308 refs (See N66-24206 13-24) CFSTI: HC $4.00/MF $1.75

A scintillation camera for scanning isotopes that emit low energy gamma or X-rays is described, in which the detecting element is an X-ray image amplifier.
NSA

N66-24228# Polaroid X-Ray Research Labs., Waltham, Mass.
RECENT RESEARCH DEVELOPMENTS AT POLAROID CORPORATION AND THEIR APPLICATION TO LOW-ENERGY RADIOGRAPHY
Herbert J. Frede *In* ORNL Proc. of Symp. on Low-Energy X-ray Sources and Gamma Sources and Appl. Nov. 1965 p 329–338 refs (See N66-24206 13-24) CFSTI: HC $4.00/MF $1.75

The Polaroid Land Type 3000 X radiographic packet which employs a high speed, panchromatized negative emulsion is described. When this film is exposed to x-radiation in conjunction with a standard, blue-emitting fluorescent screen, it is capable of producing a positive reflection image of satisfactory density with only 1/4 to 1/16 of the radiation required for standard wet-process radiographic films. The panchromatic sensitization of these radiographic packets allows their use with intensifying screens having a variety of emission bands. The application of Polaroid photographic technology to flat film X-ray diffraction analysis so as to produce satisfactory forward Laue, back reflection Laue, and precession patterns is discussed. Illustrations of results and pictures of the equipment are given.
NSA

N66-24281# United Nuclear Corp., White Plains, N. Y. Development Div.
THE LIQUID METAL OXYGEN METER
B. Minushkin *In* AEC Proc. of Sodium Components Develop. Program Inform. Meeting, Chicago, Ill., Jun. 16–17, 1965 [1965] p 271–275 refs (See N66-24266 13-22) CFSTI: HC $3.00/MF $1.50

The design, development, and testing of a liquid metal oxygen meter are described. The meter is an on-line instrument for continuously monitoring the effective oxygen content in sodium. The meter is rugged and suitable for use in sodium systems under field conditions, is specific for oxygen, and useful at low oxygen levels in the range from 1 ppm to 100 ppm. It is extremely sensitive to small changes in oxygen concentration, has a rapid response to changes in oxygen content, is relatively insensitive to changes in sodium temperature, and is independent of sodium velocity over reasonably large ranges.
R.N.A.

N66-24413# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Wessling (West Germany).
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS ON A WINDMILL-TYPE ANEMOMETER [THEORETISCHE UND EXPERIMENTELLE UNTERSUCHUNGEN AN EINEM FLUGELRADANEMOMETER]
Th. Dahlem and D. Paffrath Feb. 1966 43 p refs In GERMAN; ENGLISH summary
(DLR-FB-66-07) CFSTI: HC $2.00/MF $0.50

A theory has been developed for a special type of windmill-anemometer (Woltmann–Flügel) by studying the change of momentum of the air molecules bumping against the blade of the propeller. The result is a fundamental equation between the velocity of rotation, the velocity of flow, and the density of the flowing medium. After determination of three constants of the instrument by simple measuring, the anemometer calibration can be calculated by way of this equation. The theory has been proved by numerous measuring points and is found to be in very good agreement with the experiment.
Author

N66-24414# Polish Academy of Sciences, Warsaw. Institute of Nuclear Research.
APPARATUS FOR INTERNAL FRICTION AND YOUNG'S MODULI MEASUREMENTS IN KILOCYCLE RANGE

W. Malinowski May 1965 23 p refs
(Rept.-632/XIV/PS) CFSTI: HC $1.00/MF $0.50

The equipment for internal friction and Young's Moduli measurements is based on the principle of the 3-component quartz resonator method. This method gives the possibility of the evaluation of the amplitude dependent decrements over a wide range of strain amplitudes. The equipment permits to lead continuous measurements in the temperature range from −150°C to room temperature and to about 800°C. The measurements indicate a good behavior and stability of electronic circuits during investigations. Author

N66-24416# Institut Franco-Allemand de Recherches, St. Louis (France).
COMPARISON OF JOYCE'S MICROHYDROMETER WITH THE ZEISS REGISTERING PHOTOMETER [VERGLEICH DES MIKRODENSITOMETERS VON JOYCE MIT DEM REGISTRIERPHOTOMETER VON ZEISS]
H. Mach 28 Nov. 1963 29 p In GERMAN
(T-25/63) CFSTI: HC $2.00/MF $0.50

Optical density registrations were used to compare the performance of a microdensitometer with a photometer registration. Measurements on the shading of photographic emulsions showed that the microdensitometer was able to obtain higher and more accurate density values of ±0.004 optical units with immediate registration of the shading effect. The spectrophotometer registration possessed a greater resolution with a larger spectrum, but took more time since photographs had to be developed. Transl. by G.G.

N66-24422# Japan Broadcasting Corp., Tokyo. NHK Technical Research Labs.
16-mm EE CAMERA WITH MAGNETIC SOUND RECORDING
Toshiya Saito Feb. 1966 18 p refs
(S-6) CFSTI: HC $1.00/MF $0.50

Design details are given on an electric-driven camera, which incorporates such features as a high quality automatic exposure control, and a small size, lightweight single system magnetic recording device. Made of magnesium alloy, the television camera can be held in the hands, thereby eliminating the need of supporting apparatus. The zoom lens is inside the camera, with distance adjustment accomplished by the front lens manipulation method. The average brightness of an object is detected by a photoconductive cell, which controls the lens opening for correct film exposure. The structural elements of this automatic exposure control are depicted, and the operational range is graphed. The film transport mechanism is discussed in relation to the simultaneous recording device, and a block diagram of the recording amplifier is used to delineate its particular features. Tabulated data on the performance ratings and other specifications are included. M.G.J.

N66-24423# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
A HIGH TEMPERATURE X-RAY DIFFRACTOMETER FOR OPERATION UP TO 2500°C
T. W. Baker, P. J. Baldock, and W. E. Spindler Dec. 1965 36 p refs
(AERE-R-5057)

The design, temperature calibration and use of a high-temperature attachment to a Philips X-ray diffractometer is described. The instrument has been successfully proved in many applications. Author

N66-24456# Army Dept., Washington, D. C.
A SYSTEM FOR AUTOMATIC PRESSURE RECORDING IN SUBLIMATION DRYING [SISTEMA AVTOMATICHESKOY ZAPISI DAVLENIY PRI SUBLIMATSIONNOY SUSHKE PRODUKTOV]
K. P. Rusanova and V. V. Damyanovsky 4 Feb. 1966 4 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zovedeniy-Pishchevaya (Krasnodar), no. 1, 1964 p 167–171
(I-9054-F; TT-66-60607; AD-628428) CFSTI: HC $1.00/MF $0.50

The method is based on the principle of the action of a manometer with Bourdon tubes. A Bourdon tube with its stem hermtically welded, is placed in a sublimation chamber on an elastic string. On the flat portion of the manometric coil in the 'active filament' region, two tensometer pickups are cemented on each side, which are connected to an electronic bridge. In pumping air from the chamber, the coil, filled with dry air at atmospheric pressure, undergoes general expansion which is recorded by an autoscriber. (TAB)

N66-24498*# College of William and Mary, Williamsburg, Va. Plasma Physics Lab.
APPARATUS FOR RECORDING OSCILLATION PROPERTIES OF A PENNING IONIZATION GAUGE AT VERY HIGH FREQUENCIES
M. D. Holt and D. B. Raiford Jun. 1965 15 p *lts* Tech. Rept.-4 (Grant NsG-106)
(NASA-CR-74564) CFSTI: HC $1.00/MF $0.50 CSCL 14B

In extending our previous experiments on VHF oscillations in a Penning Gauge, we have assembled equipment to record simultaneously the frequency spectrum of the oscillations, the discharge current, and the gas pressure. In use, we have held the magnetic field and anode voltage fixed and varied the anode voltage synchronously with the motion of the recording film (used for the oscillation spectra) and charts. The system, which may be of use in other experiments, is described and typical data recorded for the Penning Gauge are shown and discussed briefly. Author

N66-24599*# Space-General Corp., El Monte, Calif.
MICROWAVE RADIOMETER DESIGN AND DEVELOPMENT First Quarterly Report, 1 Oct. 1965–1 Jan. 1966
[1966] 123 p refs
(Contract NAS5-9680)
(NASA-CR-71883; SGC-939R-3) CFSTI: HC $4.00/MF $1.00 CSCL 20F

Progress is reported in a program to design, develop, fabricate, and test several models of a 19.35 Gc microwave radiometer for use in meteorological satellite programs. Work is discussed which was performed in each of the various program areas, and the current status of the radiometer design and development is described. Supporting data is presented on a number of theoretical aspects of the design, practical design tradeoffs, and factors influencing system performance. Emphasis is placed on the development of an engineering model which consisted of review and evaluation of the basic design approach, refinement of various design details, breadboard performance testing of portions of the system, preliminary parts selection, and initial reliability assessments. C.T.C.

N66-24644*# National Aeronautics and Space Administration. Goddard space Flight Center, Greenbelt, Md.
PULSE TRAIN GENERATOR FOR ROCKET CAMERA
Robert S. Lee Jan. 1966 14 p
(NASA-TM-X-55454; X-814-66-37) CFSTI: HC $1.00/MF $0.50 CSCL 14E

This paper describes a solid state pulse train generator to control shutter and film advance timing of camera experiments on sounding rockets. Circuit simplicity, flexibility, accuracy, and low power consumption were the major design objectives. The final circuit configuration produces a time sequential train of four shutter timing pulses of different widths, with a fixed interval following each shutter timing pulse to allow time for advancing the film. The timing cycle begins when power is applied to the circuit, and recycles continuously until power is commanded off. Two rocket flights have shown the circuit's reliability and adaptability to rocket work. All design objectives were met. The circuit's flexibility makes it possible to obtain any reasonable pulse width and its simplicity makes duplication easy. By adding two more flip-flops in the counter string, six output pulses of 1/20, 1/10, 1/3, 1, 3, and 10 seconds with one-second spacing between each pulse may be obtained. Schematic and block diagrams are included. R.N.A.

N66-24696*# Consolidated Controls Corp., Bethel, Conn.
PRESSURE MEASURING SYSTEMS FOR CLOSED CYCLE LIQUID METAL FACILITIES Eighth Quarterly Report, 1 Dec. 1965–28 Feb. 1966
Anthony J. Cassano 8 Apr. 1966 65 p refs
(Contract NAS3-4170)
(NASA-CR-54960; CCC-546) CFSTI: HC $3.00/MF $0.75
CSCL 14B

Continuing development of a thermionic diode pressure transducer for liquid metal applications is described. Experimental results on the latest transducer test models indicate that fabrication changes introduced in the thermionic diode sensor have increased the expected operating life well beyond the 1000 hour level. The final designs of the 80 psia and ±5 psid transducers are well along. A double housing is planned; an inner Nb–1Zr main housing to establish a low vapor pressure environment for successful operation of the thermionic sensor, and an outer L-605 alloy shell to enable the transducer to be used on a liquid metal test loop operating in air. Tests on the breadboard model of the transducer electrical signal conditioning system indicated that the various control loops are operating properly. Author

N66-24755# Texas Univ., Austin. Defense Research Lab.
[CALIBRATING THREE NEW SEISMOMETERS AND DISCUSSING MECHANICAL DESIGN TECHNIQUES TO MINIMIZE THERMALLY INDUCED NOISES IN SEISMOMETERS] Quarterly Status Report, 1 Jul.–30 Sep. 1965
D. W. Evertson 24 Nov. 1965 27 p
(Contract CGS-1198)
(QSR-7)

Three additional solion universal seismometer units have been completed with improved construction features. An electronics package is included with each seismometer for response shaping and moderate voltage gain. Some earthquake recording was done at the Balcones Research Center subsurface vault. A small horizontal shake table is nearing completion. Electromagnetic pumping is being considered as an alternative calibration method. An equation of motion has been derived for the solion universal seismometer. Three new seismometers were calibrated and mechanical design techniques were considered to minimize thermally induced noises in seismometers. Author

N66-24789# Army Electronics Labs., Fort Monmouth, N. J.
A GEIGER–MULLER SURVEY METER WITH ADDED RANGE AND SAFETY
Basil Markow Aug. 1965 13 p
(ECOM-2624; AD-624599) CFSTI: HC $1.00/MF $0.50

A newly designed Geiger–Muller survey meter indicates when the instrument is swamped and adds an additional high range. Author (TAB)

N66-24824# Holman (John F.) and Co., Inc., Washington, D. C.
DETERMINATION OF SIGHTING ERRORS THROUGH VARIATION OF COLOR AND FORM OF THE SIGHTING MARKS
H. Klappstein Ft. Belvoir, Va., Army Engineer Res. and Develop. Labs., Feb. 1966 10 p Transl. into ENGLISH from Vermessungstechnik (Dresden), v. 12, no. 12, 1964 p 471–472
(Contract DA-44-009-AMC-930(T))
(ERDL-T-1817-66; TT-66-60586; AD-628332) CFSTI: HC $1.00/MF $0.50

The study is concerned with the sighting error of optical theodolites in conjunction with sighting disks in polygonometry. The sighting error is a measure for the uncertainty in pointing the line of sight of a sighting telescope on a target. It is the summary expression for the conjoined action of its four components: (1) error of the observer, (2) error of the instrument, (3) error of the medium, and (4) error of the target. Results of the investigation of the four Sighting-Error Components are presented. TAB

N66-24829# Flying Personnel Research Committee, London (England).
AN APPARATUS FOR THE MEASUREMENT OF CLOTHING INSULATION
J. D. Nelms Jun. 1964 18 p refs
(FPRC/Memo-206) CFSTI: HC $1.00/MF $0.50

An apparatus using the principle of comparison of thermal gradients and calibrated with reference to still air was constructed. Hot and cold water tanks induced thermal gradients across standards of perspex. The apparatus was found to be convenient in use and also proved to be accurate in measurement of emissivity and in separating the conductive, convective and radiative components of heat flow. Author

N66-24890# Institut Franco-Allemand de Recherches, St. Louis (France).
INSTALLATION OF A LIGHTENING RADIOGRAPH ("FEXITRON 300 KV") AND THE STUDY OF X-RADIATION PRODUCED BY A FIELD EMISSION TUBE [MISE EN SERVICE D'UN APPAREIL DE RADIOGRAPHIE-ECLAIR ("FELITRON" 300KV) ET ETUDE DU RAYONNEMENT X PRODUIT PAR UN TUBE A EMISSION DE CHAMP]
F. Jamet 22 Jan. 1964 36 p refs In FRENCH
(ISL-T-3/64) CFSTI: HC $2.00/MF $0.50

After testing and putting into operation the 300 kV "Fexitron", the characteristics of X-radiation produced by a field emission tube could be understood; data from the constructor regarding the duration of the lightening, the quality of the radiation and the precision of the release were verified. As for the total amount of emission, blackenings somewhat lower than those indicated by a specific film focus distance were found. But an absolute comparison is difficult and magnifying screens identical to those used by the constructor are not available. Transl. by R.Li.

N66-24918*# National Aeronautics and Space Administration, Washington, D. C.

DETERMINATION OF THE MAXIMAL VALUES OF THE GRAVITATIONAL DRIFT AND THE DRIFT DUE TO IRREGULAR RIGIDITY IN INTEGRATING FLOATED-TYPE GYROSCOPES [OPREDELENIYE MAKSIMAL'NYKH ZNACHENIY GRAVIATATSIONNOGO DREYFA I DREYFA OT NERAVNOZHESTKOSTI POP LAVKOVYKH INTEGRIRUYUSHCHIKH GIROSKOPOV]

G. A. Slomyanskiy May 1966 17 p refs Transl. into ENGLISH from Tekhnol. i Konstruirovaniye Giropriborov (Moscow), 1964 p 74–82

(NASA-TT-F-10104) CFSTI: HC $1.00/MF $0.50 CSCL 14B

Derivation of formulas for maximum values of drift in integrating floated-type gyroscopes, proceeding from expressions for momenta due to the imbalance and irregular rigidity of the gyro unit and assuming that the float is absolutely rigid while the gyromotor structure is not evenly rigid and has a fixed axis. The results are discussed. Author

N66-24919*# National Aeronautics and Space Administration, Washington, D. C.

OPERATION OF AN INTEGRATING FLOATED-TYPE GYROSCOPE IN THE CAPACITY OF AN ANGULAR-MOTION NONFOLLOW-UP PICKUP [O RABOTE POPLAVKOVOGO INTEGRIRUYUSHCHEGO GIROSKOPA V KACHESTVE DATCHIKA UGLA POVOROTA BEZ SLEDYASHCHEGO PRIVODA]

G. A. Slomyanskiy May 1966 15 p ref Transl. into ENGLISH from Tekhnol. i Konstruirovaniye Giropriborov (Moscow), 1964 p 83–90)

(NASA-TT-F-10105) CFSTI: HC $1.00/MF $0.50 CSCL 14B

Analysis of the error due to the device's deflection from zero point, arising when an integrating floated-type gyroscope is used, without a follow-up system, as an angular motion pickup. Suggestions are made concerning the use of such gyroscopes as pickups. Author

N66-24954*# Western Reserve Univ., Cleveland, Ohio.

[FUNDAMENTAL STUDIES ON SEMICONDUCTOR RADIATION DETECTORS] Second Annual Status Report, 1 Mar. 1965–28 Feb. 1966

Karl J. Casper [1966] 53 p refs

(Grant NsG-655)

(NASA-CR-74766) CFSTI: HC $3.00/MF $0.50 CSCL 14B

This report summarizes research progress on studies of the response functions of lithium drifted silicon detectors to monoenergetic electrons, a preliminary investigation of the temperature dependence of the resolution of lithium drifted silicon detectors, fabrication of large volume lithium drifted silicon detectors, studies of the internal Compton effect using a superconducting magnet beta ray spectrometer, ohmic contacts to silicon detectors, and studies of high Z semiconductors for radiation detectors. R.N.A.

N66-24968*# Carnegie Inst. of Tech., Pittsburgh, Pa. Biophysical Research Lab.

[DEVELOPMENT OF NEW MICROSPECTRO-PHOTOMETRIC INSTRUMENTATION] Annual Report, Oct. 1, 1965–Apr. 30, 1966

Jerome J. Wolken [1966] 28 p refs

(Grant NGR-39-002-011)

(NASA-CR-74679) CFSTI: HC $2.00/MF $0.50 CSCL 06B

The use of microspectrophotometers for the study of the spectroscopy of living cells is discussed. The limitations of previously constructed microspectrophotometers are assessed and the construction of a new model of this instrument which may be adapted to space exploration is described. The component parts of the M-5 microspectrophotometer are listed and examined in detail and a schematic diagram is included. Graphs and photographs of data collected with this instrument are shown. H.S.W.

N66-24997*# National Bureau of Standards, Washington, D. C.

THERMOGRAVIMETRIC INSTRUMENT

Leo A. Wall and Sidney Straus [1963] 20 p refs

(NASA Order R-56)

(NASA-CR-74783) CFSTI: HC $1.00/MF $0.50 CSCL 14B

A thermogravimetric instrument, capable of performing rates of volatilization measurements under both isothermal and non-isothermal conditions, has been constructed and its characteristics studied. Author

N66-25038# Atomic Power Development Associates, Inc., Detroit, Mich.

ATTENUATION MEASUREMENTS OF SOUND AND PERFORMANCE OF ULTRASONIC TRANSDUCERS IN 600 F LIQUID SODIUM

Shuh-Pan Ying and Clyde C. Scott 15 Dec. 1965 28 p refs

(Contract AT(11-1)-865)

(APDA-180) CFSTI: HC $2.00/MF $0.50

Tests were conducted to define the attenuation of sound waves in liquid sodium and to provide information necessary to the development of concepts for general-purpose under sodium scanning systems. During the testing period, three piezoelectric materials, x-cut quartz, lead metaniobate, and lead zirconate–titanate, were used. Of the three materials, the lead zirconate–titanate performed better at 600° F than either the quartz or the lead metaniobate. The ultrasonic transducers were found to work satisfactorily in liquid sodium at temperatures to and including 600°F. The ultrasonic attenuation and the velocity of sound in liquid sodium (99.95% pure) were measured in the temperature range from 220°F to 600°F, and the experimental results were investigated with regard to the theory on relaxation in liquid. Conceptual designs of two practical methods for viewing objects immersed in liquid sodium, the single transducer scanner and the electronic acoustic image conversion system, are summarized. Author (NSA)

N66-25061*# Arizona Univ., Tucson. Lunar and Planetary Lab.

PRODUCTION OF THE RANGER BLOCK III PHOTOGRAPHIC RECORDS

Ewen A. Whitaker *In* JPL Ranger VIII and IX. Pt. II: Experimenters' Anal. and Interpretations 15 Mar. 1966 p 363–382 (See N66-25046 13-30) CFSTI: HC $5.00/MF $1.25

The production and publication of photographic prints from Rangers VII, VIII, and IX are reported. The output of the receiving equipment was recorded simultaneously on magnetic tapes and on 35 mm film via two kinescopes. The procedures for each mission are described separately, along with the productions of the atlases from each camera. N.E.N.

N66-25067# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Institut für Strahlenschutz.

DETERMINATION OF THE DETECTION LIMIT IN THE MEASUREMENT OF RADIOACTIVE MATERIALS [ERMITTLUNG DER ERFASSUNGSGRENZE BEI MESSUNGEN RADIOAKTIVER STOFFE]

Christo Kambourov 1965 18 p refs In GERMAN Submitted for Publication
(SGAE-SS-2/1965)

An accurate formula for the calculation of the lowest possible detection limit at optimum measurement conditions was derived. A method for rapid determination of the minimum measurement time (blank value and total effect) is given. A value of 95% was assumed for the practical liability limit. Some quantitative problems were solved in order to make the formulas intelligible. The formula derived for the calculation of the lowest possible detection limit made it possible to determine the most sensitive instruments. Author (NSA)

N66-25069# Atomics International, Canoga Park, Calif.
FS-4 DIFFERENTIAL CURRENT TRANSDUCTOR PERFORMANCE EVALUATION
A. K. Smith 9 Jul. 1965 15 p ref
(Contract AT(11-1)-GEN-8)
(NAA-SR-MEMO-11418) CFSTI: HC $1.00/MF $0.50

The performance characteristics of the differential current transductor used on the FS-4 flight system were evaluated. The results of this evaluation indicate that the transductor can provide an accurate measure of leakage current when properly corrected by the use of end-to-end calibration data. An additional small temperature correction can also be applied. Equations defining the correction terms are developed and reported. Instrument accuracy is estimated. Author (NSA)

N66-25080# Atomic Weapons Research Establishment, Aldermaston (England).
PARTICLE SIZE ANALYSIS IN THE SUB-SIEVE RANGE WITH AN AWRE CENTRIFUGAL PHOTOSEDIMENTOMETER
M. W. G. Burt Aug. 1964 44 p refs
(AWRE-O-76/64)

A new instrument for the measurement of particle size in the sub-sieve range is described. It consists of a disc-shaped centrifuge in which the suspension is analyzed by measuring the optical density at a fixed point. Tests have given consistent and meaningful results on a variety of materials. Author (NSA)

N66-25142# Sandia Corp., Albuquerque, N. Mex.
INSTRUMENTATION ACCESSORIES FOR SEISMIC MEASUREMENTS
Oct. 1965 84 p refs
(Contract AT(29-1)-789)
(SC-M-65-330) CFSTI: HC $3.00/MF $0.75

Accessories developed to remotely control the placement and adjustment of gages used for earth motion measurements are described. Author (NSA)

N66-25144# Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.
PRINCIPLES AND OPERATION OF THE ALIGNMENT INTERFEROMETER
R. R. Baldwin and L. G. Whitten 30 Nov. 1965 33 p refs
(Contract W-7405-ENG-26)
(Y-1489) CFSTI: HC $2.00/MF $0.50

The alignment interferometer was developed as an instrument for measuring deviations from straightness. Measured values are read directly as linear displacement without resorting to trigonometric conversion techniques. Orientation of the instrument is used to readily isolate slide errors due to pitch and yaw. This technique greatly simplifies error analysis and correction. A deviation from a straight line of less than 10 microinches can be detected at a distance of two yards. Calibration is performed with routine procedures and equipment. Author (NSA)

N66-25145# Texas Nuclear Corp., Austin.
REPORT ON STUDY FOR HIGH INTENSITY RADIATION SURVEY PROBE
27 Sep. 1965 32 p
(Contract AT(11-1)-GEN-14)
(TID-22395) CFSTI: HC $2.00/MF $0.50

A High Intensity Radiation Survey Probe was designed based on a two-crystal coincidence Compton recoil spectrometer. The spectrometer weighs approximately 44 pounds and is capable of operation in fields as high as 65 R/hr. An increase in peak to Compton ratios by an order of magnitude in this spectrometer provides signal to background ratios of 3:1 for a 250 mR/hr ^{60}Co source and 1.8:1 for a 4R/hr ^{60}Co source. Ratios of 10:1 and 3:1 are obtained for comparable ^{137}Cs radiation fields. The efficiency is the order of 10^{-3} and the resolution is approximately 15% for ^{137}Cs. Improved crystals may well increase the resolution and signal to background ratio. Author (NSA)

N66-25181# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
SUN TRACKER [POINTEUR SOLAIRE]
Jean Besson 1965 44 p refs In FRENCH; ENGLISH summary
(ONERA-TN-88(1965))

The sun tracker is mounted on a space vehicle and it must indicate the direction of the sun. Its main characteristics are great accuracy of its angular indication, good behavior in severe space environment, small mass and volume, and low consumption. An optical system associated with cells permits it to detect the direction of the sun whatever the attitude of the platform of the tracker. The static and dynamic possibilities are obtained through a servo-loop giving an angular precision of a few minutes of arc. Author

N66-25218# Los Alamos Scientific Lab., N. Mex.
A COMPARISON OF DIFFERENT METHODS OF PARTICLE SIZE ANALYSIS
A. L. Hipp 7 Jan. 1966 33 p refs
(Contract W-7405-ENG-36)
(LA-3424-MS) CFSTI: HC $2.00/MF $0.50

Particle size analyses were performed on several tungsten powders using four different methods for comparison. Two of the methods measured only specific surface and the other two measured particle size distributions. An application of log normal transformations was made to calculate specific surface from the size distributions and to compare the distributions obtained by different methods. Author

N66-25221# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
INSTRUMENT DEVELOPMENT BRANCH Annual Report 1964
Ned Wilde, T. J. Boland, and S. D. Anderson Dec. 1965 106 p refs
(Contract AT(10-1)-205)
(IDO-17112) CFSTI: HC $4.00/MF $1.00

Instrumentation used for nuclear technology was developed. Work activities of various projects covering instrumentation for (1) fuel elements, (2) chemical processing, (3)

zero power reactors, (4) health physics, (5) test reactors, and (6) accident studies are discussed. The design and application of an Xenon simulator for estimating Xenon reactivity in Spert III are discussed; and β/l measurements for Spert III, ArMF-1, PBF, ETRC, and a capsule driver core are given. In addition, hydraulic systems were analyzed. Calculations of power-time-history, spectral density functions of filter obtained by noise measurements and frequency response measurements, pressure and flow transient data for various cases, and other pertinent reactor measurements are discussed in detail. L.S.

N66-25245# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.

TRANSIENT NUCLEAR RADIATION EFFECTS ON TRANSDUCER DEVICES AND ELECTRICAL CABLES

F. D. Terry, R. L. Kindred, and S. D. Anderson Nov. 1965 86 p refs

(Contract AT(10-1)-205)

(IDO-17103) CFSTI: HC $3.00/MF $0.75

Tests were conducted on several types of transducers and electric cables to determine their suitability for use in transient radiation fields and to develop techniques for compensating some of the transducers for radiation effects. Transient radiation effects on strain gauge, inductive, capacitive, piezoelectric, photoresistive, and infrared transducers were measured in fluxes reaching 1.2×10^{16}nv and 2.3×10^{7} rads/sec. Radiation effects on single conductor and coaxial leadout cables were investigated for correlation with transducer data. Several techniques of compensating transducers for transient radiation effects were experimentally shown to provide greater than 90 percent reduction in generated spurious signals. Other compensation techniques were suggested, but have not yet been experimentally verified. Author (NSA)

N66-25257# Royal Military Coll. of Science, Shrivenham (England).

MEASUREMNT INSTRUMENTATION FOR CONTROL SYSTEM LABORATORIES

C. D. Coyle and C. M. Carne Jul. 1965 42 p refs

(EP-10)

This technical note deals with the complexity of instrumenting a student teaching laboratory control system to ensure that true measurements are taken. The requirements of control systems are examined, and a survey of current equipment available on the British market is given. Major conclusions are that care must be taken when intercoupling instrumentation and system to prevent any degrading of signal level or form. If this is expected then the use of intermediate buffer stages should be included. If the control system is being constructed for student use it would be advantageous at the design stage to consider what instrumentation is going to be used and to ensure that the two are compatible. C.T.C.

N66-25267# Naval Air Development Center, Johnsville, Pa. Aero-Electronic Technology Dept.

QUALITY CONTROL FOR TRANSDUCER CERAMICS

M. F. Pressler 21 Mar. 1966 13 p refs

(NADC-AE-6608; AD-630490) CFSTI: HC $1.00/MF $0.50

A detailed description of the construction and operation of a piezoelectric constant tester for transducer ceramics is given. Author (TAB)

N66-25276# Kitt Peak National Observatory, Tucson, Ariz.

KITT PEAK NATIONAL OBSERVATORY AND CERRO TOLOLO INTER-AMERICAN OBSERVATORY MONTHLY REPORT, JANUARY 1966

[1966] 26 p refs Sponsored by NSF

The telescope torque motor guide system for the Kitt Peak National Observatory is described, and the performance of the telescope in response to the guide buttons is indicated. The observing summaries for the 16-inch, 36-inch, and 84-inch telescopes are reported. Several center-to-limb series were obtained of four neutral iron lines of photospheric origin. The mean positions of the spectral lines at points equally spaced on the solar surface were determined. A Fourier analysis of the fluctuations in the mean positions was made, and power spectrum of the fluctuations produced. The failure of the second stellar spectrometer flight is discussed. The 16-inch telescopes at the Cerro Tololo Observatory are in operation and the continuing construction and installations are reported. N.E.N.

N66-25278# British Broadcasting Corp., Kingswood (England). Engineering Div.

DIGITAL CODING EQUIPMENT FOR RECORDING FIELD STRENGTH MEASUREMENTS

D. E. Susans 1965 18 p refs

(G-097)

This report describes a voltage coder and tape perforator which samples the dc output from one or more field strength recording receivers at regular intervals and records the values by means of a 5-unit binary code, on a paper tape which can subsequently be fed into a computer for analysis. Author

N66-25288# Sierra Research Corp., Buffalo, N. Y.

CATEGORY III ALTITUDE MONITOR Final Report

Robert J. Theisen Nov. 1965 42 p

(Contract FAA/BRD-230)

(SRDS-RD-65-125)

This report covers work on the altitude monitor. The program objectives were: (1) simultaneous altitude readout in both ground station and aircraft, (2) reduction of airborne equipment weight, (3) two equipment designs, one providing airborne and ground readout for commercial aircraft, the other ground readout (only) for light aircraft, (4) higher accuracy of altitude readout, (5) go/no-go airborne indication, (6) lower-cost equipment and (7) precise inner marker capability. Results were as follows: (1) ground readout was accomplished through the addition of an airborne FSR which returns the transmitted signal 30 mc from its original frequency, (2) airborne equipment weight was reduced to less than 5-1/2 lbs., (3) airborne equipment was miniaturized for light aircraft, (4) go/no-go airborne indication was designed into the airborne computer and flight-tested, and (5) the feasibility of precise inner marker capability was demonstrated. The doppler effect was overcome by increasing the receiver bandwidth to 4 kc and the false airborne triggering was eliminated through raising the modulating frequency. Author

N66-25309*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

CONTINUOUS MEASUREMENT OF SHOCK VELOCITY USING A MICROWAVE TECHNIQUE

M. G. Dunn and R. J. Blum Washington, NASA, May 1966 36 p refs

(Contract NAS5-3976)

(NASA-CR-490) CFSTI: HC $1.00/MF $0.50 CSCL 14B

A microwave technique for continuous measurement of shock-wave velocity has been adapted for use in the CAL shock-tube facilities. Measurements of shock-wave velocity have been made and are presented. Detailed characteristics of the shock-front propagation are determined by these measurements. Regions of shock-front acceleration and deceleration are readily observed. The influence of shock-tube characteristics and diaphragm rupture on the propagation velocity are also illustrated. Detailed circuit diagrams of the necessary electronic components are included in the Appendix.
Author

N66-25323# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Porz (West Germany). Institut fuer Angewandte Gasdynamik.
CONTRIBUTION TO THE DEVELOPMENT OF LIQUID-LEVEL-INDICATION FOR FUEL TANKS FILLED WITH AGGRESSIVE LIQUIDS STANDING UNDER HIGH GAS PRESSURE [BEITRAG ZUR ENTWICKLUNG EINER FULLSTANDSANZEIGE FUR BEHALTER MIT AGGRESSIVEN FLUSSIGKEITEN, DIE UNTER HOHEM GASDRUCK STEHEN]
Josef Thalen, Wolf Trommsdorff, and Herbert Wiegand Feb. 1966 29 p refs In GERMAN; ENGLISH summary
(DVL-468; DLR-Mitt.-66-01) CFSTI: HC $2.00/MF $0.50

This report deals with different methods for measuring the liquid-level in closed fuel tanks. A method with a capacitative probe which seems to be especially qualified for fuel tanks with aggressive liquids standing under high gas pressure is tested in detail. Finally applicabilities for which the introduction of tis method may be of importance are discussed.
Author

N66-25337# Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.
10,000-HOUR TEMPERATURE TEST OF FISSION-COUNTER PREAMPLIFIERS
G. F. Atkinson 17 Jun. 1965 24 p refs
(Contract AT(30-1)-2789)
(TIM-922) CFSTI: HC $2.00/MF $0.50

Sixteen preamplifiers amplifying the pulse outputs of irradiated fission counters and possessing high-temperature and radiation-resistant properties were tested at elevated temperatures in a program lasting over 10,000 hr. Five preamplifiers were operated at 250°F, and the remaining eleven were tested, five in operation at a given time, at 350°F. Three preamplifiers at 250°F operated for 10,100 hours without failure. Two preamplifiers at 250°F each suffered a single failure during a similar period, one failing after 7700 hr and the other after 1400 hr. After repair each operated without further failure for the remainder of the test. The original five preamplifiers at 350°F operated for 6400, 6400, 6400, 3000, and 72 hr, respectively, before first failures. Four replacement preamplifiers at 350°F operated for 3000, 2900, 2100, and 500 hr, respectively, before first failures. Two replacement preamplifiers at 350°F each operated 3600 hr without failure. The principal mechanism of failure was the degradation of capacitor insulation resistance. A thorough post-test examination was given all test items. It was concluded that the preamplifier design is suitable for long-term 250°F service but not at 350°F, although modifications to increase reliability at both temperatures are suggested.
Author (NSA)

N66-25360# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
AN ADHESION TESTER FOR EVAPORATED METAL FILMS
R. L. Beno 11 Jan. 1966 12 p
(Contract AT(29-1)-1106)
(RFP-672) CFSTI: HC $1.00/MF $0.50

A tensile tester for measuring the bond strengths of vapor-deposited metallic coatings is described. Film adherence values are read directly in pounds pull from a precision-force gage. Accuracy of the force gage is ±0.5 percent of the full scale reading over the entire range.
Author (NSA)

N66-25370*# Georgia Inst. of Tech., Atlanta.
A SUBMILLIMETER INTERFERENCE SPECTROMETER: CHARACTERISTICS, PERFORMANCE AND MEASUREMENTS
K. H. Breeden, W. K. Rivers, and A. P. Sheppard Washington NASA, May 1966 49 p refs
(Grant NsG-258)
(NASA-CR-495) CFSTI: HC $2.00/MF $0.50 CSCL 20F

An interference spectrometer facility for use in the frequency region 40 to 3000 GHz (7.5 mm to 100 μ wavelength) is described. The spectrometer resolution is limited to no less than 0.5 GHz over this range. Results are given of measurements on water vapor absorption in the 500 to 1500 GHz frequency band including a high resolution spectrum from 900 to 1000 GHz. The use of the instrument to measure dielectric constant and loss tangent of materials is described. Also included are discussions of sources, filters and detectors used and of procedures for operating this instrument.
Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N66-23920# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AN ANALYSIS OF THE ECONOMIC RISK OF THE EXPONENTIAL ASSUMPTION IN RELIABILITY TESTING
Stephen G. Dizek (M.S. Thesis) Dec. 1965 82 p refs
(GRE/SM/65-01; AD-628102) CFSTI: HC $8.60/MF $0.75

The characteristics of the exponential time to failure distribution are compared with those of Weibull life distributions with shape parameter greater than one. Computer simulation is used to determine the probability of accepting an exponential life distribution hypothesis when the distributions are Weibull. An economic model is then used to show that, for items meeting reliability specifications, the risk may increase with the shape parameter when the exponential life distribution is assumed and sampling plans based on it are used.
Author (TAB)

N66-23932# General Electric Co., Hudson Falls, N. Y. Capacitor Dept.
PRODUCTION ENGINEERING MEASURE POLYCARBONATE PLASTIC FILM Third Quarterly Report, 18 Nov. 1965-18 Feb. 1966
18 Feb. 1966 24 p
(Contract DA-36-039-AMC-06165(E))
(AD-629733) CFSTI: HC $1.00/MF $0.50

This report contains the details of the progress made during the second quarter of the polycarbonate plastic film program. (a) An automatic feed system has been designed, purchased, installed, debugged and is in operation. (b) Optimization of extrusion conditions has been essentially completed with the addition of an in line beta gauge, improvement of edge slitting and the elimination of die hang-up and degradation. (c) Optimization of drafting and tentering is being approached after solving many difficult equipment problems. In addition, efforts to make drafting and tentering synchronous has been successful. Author (TAB)

N66-23939# Army Engineer Waterways Experiment Station, Vicksburg, Miss.

EVALUATION TESTS OF MOSLER BLAST VALVES

Mark A. Vispi Feb. 1966 35 p ref Supported in part by DASA *Its* Misc. Paper No. 1-790

(AD-629405) CFSTI: HC $2.00/MF $0.50

Determinations of closure times, pressure leakage, and structural stability of the valves were primary objectives of the tests. The first valve tested was a blast-actuated, tubular-type valve in which a movable set of steel dowels seals against a stationary set. For the range of pressures tested (3 to 18 psi), the valve closing time was between 4 and 9 msec. Some deformation was observed in the hollow, stainless-steel tubes (dowels) of the valve. The second valve tested was a blast-actuated, disk-type, 16-inch-diameter valve in which the disk seals against a steel seat assembly. This valve was not effective in sealing off the airblasts. The third valve tested was a remote-controlled, pressure-operated cylinder, 36-inch-diameter valve. In a series of 24 opening and closing cycles, the closing time averaged 73.1 msec and the opening time averaged 1.24 seconds; both times are well within the specified range. The valve showed no pressure leakage when subjected to pressures up to 80 psi and no structural damage was observed. Of the three designs tested, this valve gave the best results. Author (TAB)

N66-23956# Naval Avionics Facility, Indianapolis, Ind.

SILICON MONOXIDE BAFFLED BOX EVAPORATION SOURCE CAPABILITY

Clifford M. Ault 30 Nov. 1965 27 p

(NAFI-TR-687; AD-629706) CFSTI: HC $2.60/MF $0.50

The report outlines the characteristics of operation, control and film distribution attainable with a baffled box type SiO evaporation source in the in-line thin film deposition machine. Author

N66-23962# General Electric Co., Baltimore, Md. Insulator Dept.

ENGINEERING SERVICES IN CONNECTION WITH TEST OF EXISTING OPEN AND CLOSED TYPE GUY INSULATORS AND A FEASIBILITY STUDY OF IMPROVED DESIGNS FOR HIGH STRENGH ALUMOWELD CABLES

Final Report, 2 Jul. 1965-17 Feb. 1966

17 Feb. 1966 46 p

(Contract NBy-62174)

(LK-805; AD-629439) CFSTI: HC $2.00/MF $0.50

Results of testing strings of open and closed type fail-safe guy insulators show a linear relationship between peak-wet flashover rating and number of units in a string. The effect of grading rings and spacing of insulator units is demonstrated. Author

N66-24013# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MACHINING OF DETAILS OF POWER FRAME OF WING AND EMPENNAGE ON MACHINES WITH PRESET CONTROL

V. A. Osipov *In its* News of Inst. of Higher Learning Jan. 1966 p 219-231 refs (See N66-23994 13-01) CFSTI: HC $26.30/MF $1.25

This investigation was conducted to calculate tool trajectories for three cases of formation involving linear undeveloped wing and empennage type surfaces. The result is an algorithm for calculating the program for machining errors for the investigated surface are calculated for three, four, and five coordinate machines. The dependence is established between the magnitude of error for the treatment method and the geometric characteristics of the investigated surface. The effectiveness of applying equipment with preset control, necessary for selecting machines with a minimum number of controlled coordinates to insure a minimum error of machining actual detail, is analyzed. R.N.A.

N66-24014# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

TECHNOLOGICAL CALCULATIONS OF OPERATIONAL LINEAR DIMENSIONS FOR MACHINING WITH APPLICATION OF SEPARATE SUMMATION OF SYSTEMATIC AND ACCIDENTAL ERRORS

V. Ya. Fadeyev *In its* News of Inst. of Higher Learning 6 Jan. 1966 p 232-243 refs (See N66-23994 13-01) CFSTI: HC $26.30/MF $1.25

Calculations are presented for determining the operational linear dimensions needed for the technological processes of machining using preliminary setup machines. A method is offered for the separate summation of random and systematic errors. The random errors are summarized in accordance with the rules of probability theory. The systematic errors, because of their heterogeneities and distinctions in the course of the technological process, are added arithmetically. R.N.A.

N66-24016# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

TWO METHODS OF CENTERING

V. A. Bulychev and B. Ye. Shalimov *In its* News of Inst. of Higher Learning Jan. 1966 p 251-259 refs (See N66-23994 13-01) CFSTI: HC $26.30/MF $1.25

One of the most important requirements in assembling thin walled conical shells consists of finding the geometric axis and setting it in the required position. The axis is determined by the centers of gravity of the two base sections. The problem is complicated by the fact that because of low rigidity and warping, these sections deviate from the circular. Therefore, the position of the axis must be determined by taking into account these deviations. Two new methods of centering the axis are considered. The first method, an optical-mechanical centering, is based on the self-centering of a system of radial springs connected with a contour of arbitrary form, whereby all measurements and calculations are excluded. The other method consists of automatically determining the coordinates of the center of gravity of the section with the help of a computer. R.N.A.

N66-24039# Naval Missile Center, Point Mugu, Calif.

THE ELIMINATION OF SUBSTANDARD PARTS BY ENVIRONMENTAL TESTING

Lyle E. Matthews and Raymond C. Binder (Univ. of Southern Calif., Los Angeles) *In* NRL The Shock and Vibration Bull., No. 35, Pt. 3 Jan. 1966 p 227–233 refs (See N66-24020 13-32 CFSTI: HC $6.00/MF $1.50

This paper discusses objectives, laboratory tests associated with different design states, and possible gains of laboratory debugging tests or tests to eliminate substandard parts, the principle cause of early failures. In the laboratory, each of a set of missiles was subjected to two ten-minute vibration tests under a combined temperature-altitude environment. The temperature ranged from 180° F to −30° F, and the altitude was 40,000 feet. The missile was checked for acceptable operation before, during, and after the environmental test. The missiles were later flight tested. Missiles with no early failures which operated satisfactorily after the laboratory tests were satisfactory in the flight test (on the basis of having the capability of locking on the target and guide throughout the flight). Missiles which were early failures as a result of the laboratory test, and were subsequently corrected to pass the laboratory test, were satisfactory in the flight test. Although the sample size was small, there was correlation between the laboratory tests and flight tests. Author

N66-24120*# Solar, San Diego, Calif. Research Labs.
DEVELOPMENT OF BRAZING PROCESSES FOR PYROLYTIC GRAPHITE Final Report, 1 May 1965–1 Mar. 1966
R. G. Bogowitz, A. G. Metcalfe, and John V. Long 18 Mar. 1966 39 p Prepared for JPL
(Contract NAS7-100; JPL-950717)
(NASA-CR-71768; RDR-1453) CFSTI: HC $2.00/MF $0.50
CSCL 13H

The techniques that were developed to join pyrolytic graphite to itself for use in radiation cooled thrust chambers are discussed. The joints that were made had a median shear strength of 500 psi at room temperature and essentially the same value at 1500° F with a Gaussian distribution of strength data. It is reported that succesful joints were made between pyrolytic graphite and ATJ graphite. The problem of pyrolytic graphite-to-metal joints between plates was studied but only partially succesful joints were obtained with strengths of 460 psi in shear. Preliminary work with tubes showed a difference in stress conditions compared with the flat plates, and led to a recommendation that all future work be performed with tubes. Tables which summarize the data obtained from tests are provided. H.S.W.

N66-24204# Battelle Memorial Inst., Columbus, Ohio.
FUNDAMENTALS OF SOLID STATE WELDING AND THEIR APPLICATION TO BERYLLIUM, ALUMINUM, AND STAINLESS STEEL
D. Hauser, P. A. Kammer, and D. C. Martin Redstone Arsenal, Ala., Redstone Sci. Inform. Center, 15 Jul. 1965 126 p refs
(Contract DA-01-021-AMC-11706(Z))
(RSIC-437; AD-474877)

This report presents the results of a state-of-the-art survey of solid state diffusion welding and roll welding of aerospace metals. Particular emphasis is given to Be, high-strength Al alloys, and Type 321 stainless steel. The report is divided into four major categories: (1) a general survey of solid-state diffusion welding, including a description of a real surface, factors influencing microscopic plastic flow, diffusion, grain growth, dissimilar metal welding, and use of intermediate materials; (2) a description of solid-state welding methods, including roll welding, roll-welding theory, advantages and limitations of welding methods, and joint designs that are suitable for diffusion welding and roll welding; (3) nondestructive testing techniques for solid-state welded joints and their applicability; (4) a survey of similar and dissimilar metal diffusion welding. On the basis of the information obtained, general areas in which future research is desirable are presented. Author (TAB)

N66-24233# Joint Publications Research Service, Washington, D. C.
STUDIES IN ELECTROSLAG WELDING
9 Mar. 1966 30 p refs Transl. into ENGLISH from Russian periodicals
(JPRS-34485; TT-66-30925) CFSTI: $1.00

CONTENTS:

1. INVESTIGATION OF THE METALLURGICAL PROCESSES IN THE ELECTROSLAG REMELTING OF STEEL Yu. V. Latash p 1–9 refs (See N66-24234 13-15)

2. SOME PROBLEMS OF ELECTROSLAG WELDING WITH LARGE DIAMETER ELECTRODES A. N. Safonnikov p 10–12 (See N66-24235 13-15)

3. THE QUALITY AND COST OF STEELS DI-1 AND EI961 PRODUCED BY MELTING IN AN OPEN ELECTRIC FURNANCE, IN VACUUM ARC FURNACES AND BY ELECTROSLAG REMELTING N. T. Privalov, N. A. Tulin, B. I. Medovar, and B. I. Maksimovich p 13–16 (See N66-24236 13-17)

4. OPTIMUM MODES OF ELECTROSLAG WELDING TO PROVIDE DIMENSIONAL PRECISION OF PRODUCTS I. I. Sushchuk-Slyusarenko and I. I. Lychko p 17–23 refs (See N66-24237 13-15)

N66-24234# Joint Publications Research Service, Washington, D. C.
INVESTIGATION OF THE METALLURGICAL PROCESSES IN THE ELECTROSLAG REMELTING OF STEEL
Yu. V. Latash *In its* Studies in Electroslag Welding 9 Mar. 1966 p 1–9 refs Transl. into ENGLISH from Avtomat. Svarka (Kiev), no. 9, Sep. 1960 p 25–29 (See N66-24233 13-15) CFSTI: $1.00

The effect of flux on the oxidation and desulfurization in the electroslag remelting of Armco steel was investigated. The ingots had a height of 620 to 650 mm, and specimens for chemical analysis were taken from them at a height distribution of 50, 150, 300, 450, and 600 mm from the bottom. Analyses were made for manganese, silicon, iron, and phosphorus, as well as sulfur and oxygen distributions in ingots remelted with several different fluxes. The results are presented in tabulated form. It was concluded that the use of fluxes with a high content of free calcium oxide in electroslag remelting intensifies the desulfurization of the metal. The use of fluxes with definite, optimum ratios of calcium and aluminum oxides was recommended to guarantee effective desulfurization of the metal without substantial acceleration of oxidation, especially when air is accessible to the crystallizer. N.E.R.

N66-24235# Joint Publications Research Service, Washington, D. C.
SOME PROBLEMS OF ELECTROSLAG WELDING WITH LARGE DIAMETER ELECTRODES
A. N. Safonnikov *In its* Studies in Electroslag Welding 9 Mar. 1966 p 10–12 Transl. into ENGLISH from Avtomat. Svarka (Kiev), no. 9, Sep. 1965 p 74–76 (See N66-24233 13-15) CFSTI: $1.00

The effect on the stability of the welding process of strong magnetic fields which form around the electrodes, and the effect of allotropic transformation on the tendency to crack formation in the welds are examined. The use of large diameter

electrodes is recommended to increase welding stability. When welding ferromagnetic materials, the current must not be brought directly to the object being welded, but to an insulated metallic pocket. The large diameter electrode is also recommended for welding perlitic and martensitic steels undergoing alliotropic transformations. The use of the large electrode was found to decrease the velocity of the martensitic transformation during cooling, and thus eliminate crack formation which accompanies the transformation. N.E.N.

N66-24237# Joint Publications Research Service, Washington, D. C.

OPTIMUM MODES OF ELECTROSLAG WELDING TO PROVIDE DIMENSIONAL PRECISION OF PRODUCTS

I. I. Sushchuk-Slyusarenko and I. I. Lychko *In its* Studies in Electroslag Welding 9 Mar. 1966 p 17-23 refs Transl. into ENGLISH from Avtomat. Svarka (Kiev), no. 11, Nov. 1965 p 25-27 (See N66-24233 13-15) CFSTI: $1.00

The optimum mode selection was based on the voltage, the rate of feed of the electrodes, and the number of electrodes. Since the current during welding can be controlled with less precision than the rate of feed of the electrode, the latter was considered. A rate of feed of 120-140 m/hr (for thicknesses of 150-500 mm) was recommended. Tests showed that the number of electrodes did not affect the magnitude of deformation if the rate of welding was maintained constant. A voltage of 40-45 V was considered sufficient for normal conditions. The results of temperature field measure are given in a graph, and it was concluded that it is possible to obtain a good coincidence of results with the 800-850°C and lower isotherms. N.E.N.

N66-24248# Joint Publications Research Service, Washington, D. C.

TECHNOLOGY OF PRODUCTION OF TWO-LAYER SHEET STEEL BY THE PACK METHOD

D. I. Piryazev, N. M. Khoroshilov, Yu. I. Krivonosov, P. Ya. Loktionov, Ye. A. Shul'ga et al *In its* Production of Bimetals 30 Mar. 1966 p 10-15 ref (See N66-24246 13-17) CFSTI: $6.00

A new flow diagram for the mass production of two-layered steel sheets by the pack method was developed that doubled the productivity of the milling machines by utilizing thicker slabs of the basic metal. Steel packs were heated in wells and rolled into 150 to 300 mm thickness, cut into several slab-packs, passed into 900° to 950°C furnaces, and finally rolled into two layer sheets. Obtained rollings from slab-packs were analogous in shape to rollings from small packs and showed no difference in quality control. G.G.

N66-24249# Joint Publications Research Service, Washington, D. C.

STUDY OF THE DEFORMATION AND ADHESIVE STRENGTH OF LAYERS OF STEEL-COPPER CLADS DURING HOT ROLLING

V. A. Ustimenko, S. A. Golovanenko, and L. V. Meandrov *In its* Production of Bimetals 30 Mar. 1966 p 16-28 refs (See N66-24246 13-17) CFSTI: $6.00

Deformation processes of steel-copper clads during hot rolling were studied on specimens cut from bimetallic sheets with 25 percent clad. The specimens were heated to 800-900° C and rolled by 148 mm rollers with a peripheral velocity of 0.32 m/sec. Deformation of the layers, at 35 to 80 percent compression after several passes, was then studied by their deformation resistance, flexure of the band, and adhesive strength. It was found that deformation irregularities depended primarily on the strength characteristics of the steel-copper components and their distribution. Deformation irregularities increased at lower rolling temperatures; copper-steel-copper clad sheets showed less irregular deformations than steel-copper clad, and significantly less than steel-copper-steel clad specimens. G.G.

N66-24250# Joint Publications Research Service, Washington, D. C.

DEFORMATION OF LAYERS OF TWO-LAYER STEEL SHAPES (FOR PRODUCTION OF CUTTERS FOR AGRICULTURAL IMPLEMENTS)

S. A. Golovanenko, P. S. Piekhanov, V. K. Kobyzev, S. I. Bulat, Yu. R. Mil'to et al *In its* Production of Bimetals 30 Mar. 1966 p 29-43 ref (See N66-24246 13-17) CFSTI: $6.00

Joint deformation of the layers of a double steel sheet band was studied after the band was rolled at 1160°-1180°C for 9 or 11 passages on 450 or 500 shape mills. Obtained finished profiles showed the geometric peculiarities of the bimetal nonuniform deformation. Deformation variation factors together with empirical formulations were then utilized to select the dimensions of the work-blanks in order to obtain the proper geometric relationship of the components in the finished band. G.G.

N66-24251# Joint Publications Research Service, Washington, D. C.

ROLLING OF TWO-LAYERED INGOTS OF L-53 AND Kh6F1 STEEL ON BLOOMING

P. S. Piekhanov, S. A. Golovanenko, S. I. Bulat, V. K. Kobyzev, D. G. Ryazanov et al *In its* Production of Bimetals 30 Mar. 1966 p 44-63 refs (See N66-24246 13-17) CFSTI: $6.00

The production of plows made from two-layered steel was reported. Inserts of optimal dimensions and shapes were rolled into bimetallic unsymmetric workblanks 110×200 mm in cross section and reliable welding of the steel sheets was attained during rolling on a 1100 mill under <67 percent compression at temperatures of 1160° to 1180°C. The deformation variation factors were then used to establish the initial dimensions of the rods in order to find the proper thickness ratio of the components in the finished profile. G.G.

N66-24252# Joint Publications Research Service, Washington, D. C.

ROLLING OF LARGE SIZE TWO-LAYER SHEETS WITH NONDEFORMABLE STEEL CLADDING

L. V. Meandrov and A. A. Bykov *In its* Production of Bimetals 30 Mar. 1966 p 64-78 ref (See N66-24246 13-17) CFSTI: $6.00

Large dimension two-layered steel sheets, with a clad layer from stainless steel and galvanically deposited nickel, were obtained by the pack method. Mechanical testing of the finished bimetal two-layer sheets for flexure at 120° and 180° was satisfactory. Resistance to shear along the welding plane of the layers occurred along the carbon containing metal, thus indicating the high adhesive strengths of the layers. Welding and rolling of two packs with a collecting underlayer from metallic iron, also deposited electrolytically, showed stratification along the edges of several sheets. It was concluded that the fast oxidation of the iron underlayer was responsible for the stratification phenomena. G.G.

N66-24254# Joint Publications Research Service, Washington, D. C.

ROLLING OF THICK TWO-LAYER STEEL–MONEL SHEETS ON THE 2800 MILL

S. A. Golovanenko, V. A. Ustimenko, M. V. Kovynev, B. Yu. Zelichenok, and G. N. Mul'ko *In its* Production of Bimetals 30 Mar. 1966 p 85–93 ref (See N66-24246 13-17) CFSTI: $6.00

Three symmetrical four-layer packs of carbon steel, clad with Monel, were hot rolled at 1220° to 1280°C into sheets of 20 mm thickness. Comparison of bimetal stress values obtained during rolling with those obtained during hot rolling of unclad carbon steels established little differences. Adhesive strengths of the layers and also the mechanical properties of the two-layered sheets were found satisfactory. It was concluded that the rolling of thick metallic sheets of steel–Monel under industrial conditions is feasible. G.G.

N66-24256# Joint Publications Research Service, Washington, D. C.

ROLLING OF THREE PLY NICKEL–STEEL–NICKEL

L. V. Meandrov, A. A. Bykov, Yu. V. Shilkin, S. I. Sonin, V. V. Dus' et al *In its* Production of Bimetals 30 Mar. 1966 p 104–115 ref (See N66-24246 13-17) CFSTI: $6.00

The pack method was used to obtain a three-ply nickel–steel tape for use in manufacturing processes of the electronics industry. Packs from nickel and steel plates were hot rolled at 1250°C on a 450 mill for seven passes into 3 mm thick bands. Before cold rolling, the bands were subjected to annealing, etching, and cutting. Bands were then rolled down to 0.8 mm three ply tapes, further annealed, and rolled into finished tapes of 0.2 mm thicknesses. Mechanical tests were performed after hot rolling, and also after every stage of cold rolling. It was found that the base steel layer of the three ply packs was somewhat deformed during hot rolling. Results of tensile tests on the finished three-ply bimetallic tape and extension mechanics proved satisfactory. G.G.

N66-24257# Joint Publications Research Service, Washington, D. C.

ROLLING OF TITANIUM–IRON BIMETAL

T. K. Aleksandrova and A. M. Kanunnikova *In its* Production of Bimetals 30 Mar. 1966 p 116–130 refs (See N66-24246 13-17) CFSTI: $6.00

Production of hot rolled bimetallic iron–titanium bands by the pack method with subsequent cold rolling of the obtained two-layer sheets, and also by the combined rolling of iron and titanium tapes, was studied. As starting materials titanium and vacuum treated iron were used. The heating temperature at which the specimens possessed best plasticity was determined as 800° to 850°C for titanium, and for iron 750°C and below. Hot pack rolling of the titanium–iron bimetal at about 700°C gave sufficiently welded layers. Bending of the specimens through an angle of 180° and twisting them did not cause any stratification. Subsequent cold rolling of the bimetallic band produced 0.1 to 0.3 mm thick tapes which, after annealing, possessed good plasticity. It was concluded that joined rolling of titanium tapes and iron bands into 0.1 mm thick bimetallic tapes is feasible. G.G.

N66-24258# Joint Publications Research Service, Washington, D. C.

INVESTIGATION OF THE VARIATION OF THICKNESS OF TWO-LAYER SHEETS MANUFACTURED BY THE PACK METHOD

D. I. Piryazev, N. M. Khoroshilov, Yu. I. Krivonosev, Ye. A. Shul'ga, and A. A. Syts'ko *In its* Production of Bimetals 30 Mar. 1966 p 131–139 (See N66-24246 13-17) CFSTI: $6.00

Thickness variations in two-layer sheets of steel manufactured by the pack method were studied. Measurements showed that the average thickness of the lower sheet in the rolled band was larger than the average thickness of the upper sheet. This was explained by the lower temperature in the lower part of the pack. Tests on different temperature influences at the top and the bottom of the welding zone of the heating furnace, on time of heating in the welding and malleabilizing zones, and on temperatures of the malleabilizing zone showed that the various sheet thicknesses decreased with a temperature rise in the malleabilizing zone. Thickness differences were somewhat smaller during rolling of two-layer sheets from large packs. It was concluded that only heating of packs in well or chamber type heating devices will lower the variability in sheet thicknesses. G.G.

N66-24259# Joint Publications Research Service, Washington, D. C.

HOT EXTRUSION OF CLAD SHAPES

A. N. Chernov, S. A. Golovanenko, and V. V. Gulaev *In its* Production of Bimetals 30 Mar. 1966 p 140–151 refs (See N66-24246 13-17) CFSTI: $6.00

The manufacture of round and shaped bimetallic profiles by the hot pressing method was studied on experimental lots of copper clad steel blanks, alloys on iron or chrome–nickel bases, and also on non-ferrous alloys. Extrusion was conducted on a vertical hydraulic press at 800 t pressure from a container with 80 mm internal diameter. Transverse dimensions of the initial workblanks were calculated from beforehand selected diameters of rods and cladding thicknesses. It was shown that outflow of core metal and cladding were largely determined by the design of the initial bimetallic workblanks; workblanks with closed ends decreased the distribution irregularity of the cladding layer along the length of the rod. Obtained extruded rods had good bimetallic profiles with various combinations of metals. G.G.

N66-24421# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.

HIGH DEFINITION RADIOGRAPHY

R. S. Sharpe Dec. 1965 30 p refs (AERE-R-5095)

At low kilovoltages, definition and resolution in a radiograph are set by geometrical unsharpness in the image and by the graininess of the film emulsion used to record the image. Direct visual observation of radiographs is usually adopted in industrial radiography and used as the basis for setting defect specifications. This practice has led to the establishment of an arbitrary level of radiographic quality linked to the characteristics of conventional X-ray equipments and radiographic films. The ultimate resolution obtainable on a laboratory scale is far in excess of that normally achieved in radiography, and micro X-ray techniques are now available to complement optical micrography. This report examines the practicability of using an electron-focused X-ray microscope to extend the field of conventional radiography. Image definition can be improved by up to two orders of magnitude and as a consequence completely new fields of radiographic application can now be envisaged. Author

N66-24474# National Academy of Sciences—National Research Council, Washington, D. C.
FINAL REPORT OF THE PANEL ON LUBRICATION TO THE AD HOC COMMITTEE ON METALWORKING PROCESSES AND EQUIPMENT
Sep. 1965 41 p refs
(Contract ARPA SD-118)
(MAB-220-M)

The state-of-the-art of knowledge in friction and lubrication as they relate to deformation processes and equipment utilization in metal working, was surveyed. Proper selection of a lubricant has to consider individual requirements of low friction and low wear characteristics for specific forming conditions; lubricants also control the temperature of a work piece or die in the deformation process. Equations, based on the law of adhesion, were used to determine the frictional force developing under loading conditions at the area of contact. Friction, size, and number of wear particles were influenced by the similarity as well as the hardness of the surface contact of dry, unlubricated metals and quantitative predictions on friction or wear of unlubricated metals under different sliding conditions were not obtained. Testing of unlubricated, contacting metal surfaces for friction, wear, metal transfer, and surface finish was found to be the best method to assure compatibility and proper lubrication. G.G.

N66-24604*# Mechanical Technology, Inc., Latham, N.Y.
LUBRICANT LIFE TESTS ON BALL BEARINGS FOR SPACE APPLICATIONS Final Report
S. F. Murray and P. Lewis 28 Oct. 1965 85 p refs
(Contract NAS5-9020)
(NASA-CR-71695; MTI-65-TR-55) CFSTI: HC $3.00/MF $0.75 CSCL 13I

An experimental program has been conducted to compare the effective lives of ball bearings operating in vacuum with various types of MoS_2 solid films, and with a special high vacuum oil, as lubricants. The test bearings were size 205 bearings running at 30 rpm under a ten-pound radial load. Two particular combinations were also evaluated in oscillating motion tests. Torque was used as the criterion for failure. The results showed that most of the solid film lubricated bearings were effective for the first several hundred hours, then gave high and erratic torque values as the result of debris being formed by wear of the lubricant film. A sodium silicate bonded solid lubricant film, which contained MoS_2 and graphite, was found to be particularly promising in both rotation and oscillation. One particularly significant result was the finding that the oil-lubricated bearings showed a sudden, large increase in torque after running effectively for about 1400 hours in vacuum. This behavior has often been predicted but has apparently never been observed experimentally, at least for rolling contact bearings. Author

N66-24657# Solar, San Diego, Calif.
JOINING STEEL TO ALUMINUM
Feb. 1965 22 p
(RDR-1258A)

A bimetal joining process is presented for efficiently joining any aluminum alloy with a solidus temperature of 1100°F or higher to most stainless steels and superalloys. The essential elements of the process include conditioning the stainless steel and brazing it to the aluminum alloy. At present, this process is limited to diameters up to 8 inches. Tables are included of tensile shear strength data on brazed joints and couplings. Results of thermal cycling tests showed that the coupling will withstand temperatures encountered in welding and also multiple thermal cycling up to or near the solidus of the brazing alloy without losing leak tightness. After 100-hour salt spray exposure tests, only negligible corrosion in the bimetal joints was detected; and with a passivation treatment, no stress corrosion. N.E.N.

N66-24672# Boeing Co., Seattle, Wash. Aerospace Div.
COMPARISON OF PENETRANT AND X-RAY FOR DETECTION OF WELD SURFACE CRACKS
J. G. Johnston [1965] 31 p
(TS-6539-17)

This document reports results of a lab study conducted to determine the relative abilities of penetrant and X-ray to show surface cracks in welds. Author

N66-24712# Naval Air Development Center, Johnsville, Pa.
AUTOMATIC SONOBUOY FUNCTION SELECTOR
E. J. Cotilla 26 Jan. 1966 21 p
(NADC-AE-6526; AD-629724) CFSTI: HC $2.00/MF $0.50

An in-house program was conducted to develop a method to automatically select a sonobuoy function, i.e., life or hydrophone depth as the sonobuoy is launched from an aircraft. This report contains a discussion of the design approach, a description of the selected method and a list of the test results. Author (TAB)

N66-24725# Battelle Memorial Inst., Columbus, Ohio.
A STUDY OF SLEEVE BEARINGS IN AIRCRAFT SUPPORT STRUCTURES Summary Report
W. A. Glaeser, M. F. Amateau, and C. M. Allen 1 Feb. 1966 47 p
(Contract NOw-62-0432-c)
(AD-628937) CFSTI: HC $2.00/MF $0.50

A research program was conducted to develop design information and data for plain airframe bearings. The type of information developed in this program included bearing life, load-carrying ability, frictional characteristics, and bearing wear rates. Emphasis was placed on grease-lubricated, high-strength steel bearings and self-lubricating Teflon-fabric bearings. Prior to the experimental work, a survey was made of airframe manufacturers to determine the present and future needs for plain-bearing design information. Based on the results of the survey, bearing materials were selected and their operating characteristics measured in an airframe-bearing-evaluation apparatus. TAB

N66-24811# Springfield Armory, Mass.
INVESTIGATION OF SONIC TECHNIQUES FOR THE NONDESTRUCTIVE EVALUATION OF SINTERED IRON POWDER COMPACTS
R. H. Brockelman 28 Jan. 1966 43 p refs
(SA-TR19-1515; AD-628538) CFSTI: HC $2.00/MF $0.50

Work relative to the development of nondestructive testing techniques for the inspection of sintered metal powder components is described. This study was necessitated by the fact that the major criteria for evaluation of sintered metal powder components, i.e., composition and density, do not alone adequately insure quality or performance in applications where high strength and reliability are needed. The work described is concerned with the sonic testing of sintered electrolytic iron powder compacts. Ultrasonic and resonance techniques were utilized to investigate such factors as sound velocity and attenuation, resonant frequency, and damping

capacity. These data were then correlated with processing variables, strength properties, and microstructure.
Author (TAB)

N66-24817# Valpey Crystal Corp., Holliston, Mass.
INDUSTRIAL PREPARADNESS MEASURE, QUARTZ CRYSTAL UNIT, CR-(XM-37)/U Final Report
[1965] 141 p
(Contract DA-36-039-SC-85972)
(AD-628517) CFSTI: HC $14.60/MF $1.00

The report consists of four sections. Problems encountered during fabrication of CR-(XM-37)/U in the frequency range 150 mc to 200 mc are discussed in Section I. Yield figures based on Preproduction and Pilot Run are shown. Section II contains test data during various stages of development. Also illustrated are mounting details and tabulation of holder resistance, inductance and capacitance. Processing is detailed in Section III. The Quality Control and Inspection Plan is contained in Section IV.
Author (TAB)

N66-24860# Army Tank-Automotive Command, Center Line, Mich. Materials Lab.
DEVELOPMENT OF RADIOGRAPHIC PROCEDURES AND STANDARDS FOR PARTIAL PENETRATION WELD JOINTS ON HEAVY ALUMINUM AND STEEL PLATE
Walter F. Wulf Jun. 1965 29 p
(TR-8910; AD-473499)

Weld flaw specimens were fabricated from heavy aluminum and steel plate as Phase I of a multi-year effort, to establish a military document containing reference standards and radiographic test procedures for quality control of partial penetration-weldments. The various types of flaws known to occur in partial penetration welds were produced with production-reproducible welding procedures, and were radiographically graded according to pre-established severity levels. Recommended radiographic inspection procedures were also experimentally determined for eight basic partial penetration joint designs.
Author (TAB)

N66-24870# Chalmers Univ. of Technology, Goteborg (Sweden). Inst. of Machine Elements.
THE JOURNAL BEARING CONSIDERING VARIABLE VISCOSITY
Bengt Hakansson 1964 77 p refs *Its* Trans., No. 298 (Rept.-25) CFSTI: HC $3.00/MF $0.75

The hydrodynamic theory of lubrication with variable viscosity due to temperature and pressure is investigated. Basic expressions are derived for a general case with variations in all three directions, and these are applied to journal bearing arrangements assuming constant temperature and pressure throughout the oil film thickness. Consideration is taken to cavitation regions where they appear. Methods of predicting the working temperature of a bearing are discussed, and a method for determining the inlet oil temperature is put forward. Theoretical studies of running characteristics of a bearing arrangement showed that a change in the running parameters may cause the bearing to exhibit unstable behaviour. Tests have been made at high loads to study the relationship between load and power loss. Tests have also been made to study the oil exchange in the groove. Temperature measurements have been made in the bearing. Tables and diagrams indicating bearing quantities for bearing arrangements are given. A schedule of calculation and examples are given, together with a comparison with the isothermal theory.
Author

N66-24888# Royal Netherlands Aircraft Factories Fokker, Amsterdam.
RESULTS OF FATIGUE TESTS ON LUGS WITH REFERENCE TO THE STANDARD CURVES DERIVED BY HEYWOOD AND LARSSON
A. A. Jongebreur 27 Sep. 1965 11 p
(SM-37) CFSTI: HC $1.00/MF $0.50

Specimens consisting of two lugs were subjected to fatigue tests, and the results compared to standard curves. It was concluded that the standard alternating stresses calculated according to Larsson's method are in good agreement with the standard curve, whereas those calculated with Heywood's formula show no agreement with his standard curve.
N.E.N.

N66-24966*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
210 FT ADVANCED ANTENNA SYSTEM: REPORT ON HYDROSTATIC BEARING DAMAGE
H. P. Phillips and W. D. Merrick 8 Nov. 1965 93 p
(NASA-CR-74001) CFSTI: HC $3.00/MF $0.75 CSCL 13I

An investigation was conducted following an accident which caused damage to the azimuth hydrostatic thrust bearing on the 210 ft advanced antenna system. The results of this investigation together with tests on the hydraulic system indicated that mis-set relief valves in the hydraulic supply system were the primary cause of the accident. The resulting relief valve action diminished the flow to the pads that are necessary to maintain proper bearing operation. It was also determined that the partial closing of the shutoff valves downstream of the relief valves, undersizing of the high pressure filters and possibly the presence of foreign particles in the sill area under the pads were also contributing factors. It is reported that the accident was due entirely to human error and that the basic system design is sound. It was suggested that safety interlocks be included to prevent reoccurrences of similar accidents. Included are photographs of the damage and statements from the principal investigators.
H.S.W.

N66-24977*# Mechanical Technology, Inc., Latham, N. Y.
THE SOLUTION OF SPECIAL SQUEEZE FILM GAS BEARING PROBLEMS BY AN IMPROVED NUMERICAL TECHNIQUE
S. B. Malanoski and C. H. T. Pan Feb. 1966 60 p refs
(Contract NAS8-11678)
(NASA-CR-74672; MTI-65TR26) CFSTI: HC$3.00/MF $0.50 CSCL 13I

A computer program has been written in order to compile data for special squeeze film gas bearings. In particular, three problems are solved, (1) the spherical squeeze film gas bearing with large axial and large radial displacements and finite axial excursion, (2) the cylindrical squeeze film gas bearing of finite L/D with no restriction on radial displacement or angular misalignment, and (3) the conical squeeze film gas bearing with no restriction on radial displacement or angular misalignment. Some new design data is presented for the bearings mentioned above and comparisons are made with previously published results.
Author

N66-24995*# Mechanical Technology, Inc., Latham, N. Y.
ON THE SLOWLY TIME DEPENDENT PROBLEM OF SQUEEZE FILM BEARINGS
C. H. T. Pan, T. Chiang, and H. G. Elrod, Jr. Feb. 1966 54 p refs
(Contract NAS8-11678)
(NASA-CR-74722; MTI-66TR7) CFSTI: HC $3.00/MF $0.50 CSCL 13I

The stability and vibration response of a spherical squeeze-film hybrid bearing were analyzed theoretically. Since the squeeze frequency is typically much higher than the vibration frequency, the asymptotic analysis for large squeeze number can be applied here. Perturbation solutions about the radially concentric position were obtained for small vibration amplitudes and small radial displacement. There is no limitation, however, in the values of vibration number (as long as it is small in comparison with the squeeze number), compressibility number, axial displacement ratio, and excursion ratio. Dynamic bearing reactions were computed based on the perturbation solutions. Results indicate that a spherical squeeze-film bearing is always stable in the axial direction. In the radial direction, however, instability about the radially concentric position is possible when there is journal rotation; the frequency of instability is exactly one-half the rotational frequency; the system would be stable if the mass is kept below the critical value. The analysis can be readily extended to compute the response to vibratory excitation in either the axial or the radial direction. Author

N66-25006*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

THE MAKING OF TITANIUM AND TITANIUM-ALLOY SHAPES BY CASTING, POWDER METALLURGY, AND OTHER PROCESSES

J. G. Kura, V. D. Barth, H. Mc Curdy, W. H. Safranek, E. T. Hall et al 18 Apr. 1966 133 p refs Prepared by Battelle Mem. Inst. under subcontract from Army Missile Command
(NASA Order H-76715; Contract DA-01-021-AMC-11651(Z))
(NASA-TM-X-53437; RSIC-471) CFSTI: HC $4.00/MF $1.00
CSCL 13H

The state-of-the-art of making titanium and titanium alloy shapes by methods other than machining from wrought materials is reviewed. The methods covered are casting, powder metallurgy, metal spraying, electroforming and chemical vapor deposition. Of these methods only casting and powder metallurgy are being used to any great extent or offer a great deal of promise. Metal spraying may have some very specialized applications. In their present state of development electroforming and chemical vapor deposition are not promising methods for making titanium parts. Author

N66-25007*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

MECHANICAL FASTENING OF TITANIUM AND ITS ALLOYS

D. L. Cheever, R. E. Keith, R. E. Monroe, and D. C. Martin 20 Apr. 1966 77 p refs Prepared by Battelle Mem. Inst. under subcontract from Army Missile Command
(NASA Order H-76715; Contract DA-01-021-AMC-11651(Z))
(NASA-TM-X-53442; RSIC-502) CFSTI: HC $3.00/MF $0.75
CSCL 13H

This report emphasizes the differences that are encountered in designing, forming, machining, and assembling titanium joints as compared with the standard practices for more common alloys. Author

N66-25008*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

THE CASTING AND POWDER-METALLURGY FORMING OF PRECIPITATION-HARDENABLE STAINLESS STEELS

J. G. Kura, V. D. Barth, and H. O. Mc Intire 20 Apr. 1966 54 p refs Prepared by Battelle Mem. Inst. under Subcontract from Army Missile Command
(NASA Order H-76715; Contract DA-01-021-AMC-11651(Z))
(NASA-TM-X-53444; RSIC-491) CFSTI: HC $3.00/MF $0.50
CSCL 13H

The state of the art of making shapes of precipitation-hardenable stainless steels by methods other than machining from wrought materials is reviewed. The methods reviewed are casting and powder metallurgy. Of these methods, only casting is extensively practiced. Powder metallurgy is a promising procedure for 17-4 PH stainless, but techniques are not well advanced for handling the grades that contain titanium or aluminum such as PH 15-7 Mo and A-286. Author

N66-25009*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

HEAT TREATMENT OF TITANIUM AND TITANIUM ALLOYS

F. F. Schmidt and R. A. Wood 20 Apr. 1966 77 p refs Prepared by Battelle Mem. Inst. under Subcontract from Army Missile Command
(NASA Order H-76715; Contract DA-01-021-AMC-11651(Z))
(NASA-TM-X-53445; RSIC-493) CFSTI: HC $3.00/MF $0.75 CSCL 13H

This report describes the methods, techniques, and equipment currently employed in the thermal treatment of titanium materials, and the necessary processing considerations and precautions that govern these treatments. The metallurgical background illustrating the principles used in titanium heat treatment is also discussed with respect to alloy classifications, structures, and hardening mechanisms. Author

N66-25010*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SURFACE TREATMENTS FOR NICKEL AND NICKEL-BASE ALLOYS

C. M. Jackson and A. M. Hall 20 Apr. 1966 152 p refs Prepared by Battelle Mem. Inst. under subcontract from Army Missile Command
(NASA Order H-76715; Contract DA-01-021-AMC-11651(Z))
(NASA-TM-X-53448; RSIC-513) CFSTI: HC $5.00/MF $1.00
CSCL 13H

The treatments covered are diffusion coating, electroplating, electroless plating, hard facing, surface treatment for purposes of lubrication, explosive hardening, peening, burnishing and planishing. Each treatment is described and its application to nickel and nickel-base alloys is discussed. Reasons for using the treatment are covered, as are the effects of the operations involved on appropriate properties of nickel and nickel-base alloys. Problem areas are defined. Author

N66-25034# Neratoom, N. V., The Hague (Netherlands).

METHODS IN THE FABRICATION OF PRESSURE VESSELS Quarterly Report No. 14, 1 Jul.-30 Sep. 1965

1 Oct. 1965 13 p refs Transl. into ENGLISH from the Dutch (Contract EURATOM-069-61-12 RDN)
(EURAEC-1473; EUR-2394) CFSTI: HC $1.00/MF $0.50

The effects of varying the Cr, Ni, and Mo contents of the weld metal on the tensile properties of welds produced by gas arc welding under CO_2 was measured. It is concluded to be feasible to weld 200 mm thick 1.2 MD07 steel by the boxed CO_2 method using solid weld wire and with three electrodes. NSA

N66-25064*# General Electric Co., Cincinnati. Space Power and Propulsion Section.

MATERIALS FOR POTASSIUM LUBRICATED JOURNAL BEARINGS Quarterly Progress Report No. 9, Apr. 22-Jul. 22, 1965

R. G. Frank, ed. [1965] 96 p refs
(Contract NAS3-2534)
(NASA-CR-54892) CFSTI: HC $3.00/MF $0.75 CSCL 13I

The selection of candidate materials that are suitable for for potassium lubricated journal bearings and shaft applications in space system trubogenerators is reviewed, and the test facilities used in the program are described. To evaluate the compatibility of selected candidate bearing material combinations in a potassium/Cb-1Zr alloy system, nine 1000 hour isothermal capsule corrosion tests were conducted. The results of these tests are evaluated. Metallographic examinations were conducted for all specimens that were exposed to potassium, and those specimens which exhibited some corrosion reaction are identified. It is reported that visual examination and dimensional and weight data obtained from specimens exposed to potassium at 800° and 1200° F generally showed less change than specimens exposed for 1000 hours at 1600° F. Tables which summarize the data obtained are provided. H.S.W.

N66-25113# Institut de Soudure, Paris (France).
WELDED JOINTS ON HEAVY GAUGE STEEL SHEETS Quarterly Reports 4 and 5, 1 Apr.–30 Sep. 1965
29 Nov. 1965 19 p Transl. into ENGLISH from French
(Contract EURATOM-007-64-TEEF(RD))
(EURAEC-1518; EUR-2670) CFSTI: HC $1.00/MF $0.50

Development of an oxygen-chamfering process for preparing grooves in thick steel plates for welding studies is reported. NSA

N66-25157# Kaman Aircraft Corp., Colorado Springs, Colo. Nuclear Div.
NEW DEVELOPMENTS IN NEUTRON ACTIVATION SYSTEMS FOR ANALYSIS OF OXYGEN IN STEEL
D. E. Wood, P. L. Jessen, and R. E. Jones [1966] 43 p refs Presented at 1966 Conf. on Anal. Chem. and Appl. Spectry. Pittsburgh, 21–25 Feb. 1966

Neutron activation analysis of oxygen in steel has previously been proven fast, reliable, and accurate on a laboratory basis. New developments in neutron generators and pneumatic transfer systems have made the technique suitable for routine quality control applications by technicians with minimum training. Sealed-tube fast neutron generators have been developed with outputs in the range of 10^{10} to 10^{11} neutrons/second to eliminate the hazard associated with handling tritiated titanium targets in pumped accelerators. Neutron flux monitoring is achieved with a transfer standard in a second transfer tube. Sample and standard are rotated on two axes to insure identical irradiation. Comparison with single rotation, no rotation, and remote flux monitors indicates an order of magnitude improvement in reproducibility. Measurements at low levels (around 10 ppm) have been improved by reducing the "blank" value due to the carrier bottle from the equivalent of 60 ppm in steel to 10 ppm equivalent for samples of uniform size. Author

N66-25158# Bureau of Mines, Albany, Oreg.
HIGH ENERGY-RATE FORGING AND EXTRUSION AND THE EFFECT ON STRUCTURE AND PROPERTIES
Jack G. Croeni, John S. Howe, Jr., and Haruo Kato 1966 40 p refs
(BM-RI-6757)

A study was made to determine the influence of high energy-rate deformation on the structures and properties of low-carbon steel, stainless steel, titanium-6 percent aluminum-4 percent vanadium, beryllium, molybdenum, and tungsten. The purpose of this study was to determine relative formability, the effect of energy and temperature on metal-working parameters and resulting structures, and the properties of materials formed by this technique. Forming techniques were limited to upset forging and direct extrusion on pneumatic-mechanical forming machines. Results show that considerable grain refinement can be achieved by careful control of deformation and forming temperature by high energy-rate techniques. Significant improvements in strength were observed as a result of this refined structure. Approximate deformation resistance as a function of temperature was determined for a variety of materials. Author

N66-25187# Laboratorium fur Betriebsfestigkeit, Darmstadt (West Germany)
[MECHANICAL PROPERTIES OF STEELS, STEEL ALLOYS, ALUMINUM ALLOYS, AND TITANIUM]
[1965] 120 p refs CFSTI: HC $4.00/MF $0.75

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4. METHODS FOR INCREASING THE FATIGUE STRENGTH OF ALUMINUM-ALLOY LUGS SUSCEPTIBLE TO FRETTING E. Gassner 5 p refs
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9. FATIGUE STRENGTH OF NOTCHED SPECIMENS OF MARAGING STEEL IN THE FINITE LIFE RANGE W. Schütz 8 p ref
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14. STRENGTH OF ALUMINUM ALLOY LUGS OF 2014-T6 UNDER PROGRAM LOADING O. Buxbaum 5 p refs

N66-25228# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
A METALLOGRAPHIC HOT-STAGE FOR PLUTONIUM
R. L. Greeson, W. L. Johns, and R. J. Jackson 22 Oct. 1965 20 p refs
(Contract AT(29-1)-1106)
(RFP-548) CFSTI: HC $1.00/MF $0.50

A high-vacuum, hot-stage microscope suitable for use with plutonium is described. Excerpts from movie films of the

alpha-to-beta and beta-to-alpha tranformation on high purity plutonium are also presented and discussed. Author (NSA)

N66-25328# Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.
ISOSTATIC HOT PRESSING
R. P. Levey 30 Dec. 1965 78 p refs
(Contract W-7405-ENG-26)
(Y-1487) CFSTI: HC $3.00/MF $0.75

An isostatic hot-pressing system was developed at 15,000 to 30,000 psi for large compacts. Process demonstrations illustrated the practicality of the system with eight-inch-diameter bars at 2000°C and twelve-inch-diameter bars at 1200°C. Furthermore, the data indicate that a modification of the existing equipment will provide capacity to forty inches in diameter at 2500°C and 30,000 psi. Author (NSA)

N66-25335# Los Alamos Scientific Lab., N. Mex.
FORMING OF TEFLON SHEET BY POWDER ROLLING
H. Sheinberg 5 Aug. 1965 14 p
(Contract W-7405-ENG-36)
(LA-3340-MS) CFSTI: HC $1.00/MF $0.50

A description is given of the equipment and process used to form high density Teflon sheet by powder rolling. Data on roll opening and rolled and sintered density for three Teflon powders are presented. Author (NSA)

N66-25363 Union Carbide Nuclear Co., Oak Ridge, Tenn.
EVALUATION OF A DUPLICATOR LATHE WITH HYDROSTATIC BEARING SLIDES AND AN ELECTROHYDRAULIC CONTROL SYSTEM
J. B. Richards 29 Dec. 1965 33 p
(Contract W-7405-ENG-26)
(Y-1498) CFSTI: HC $2.00/MF $0.50)

An American 25-inch duplicator lathe was modified with hydrostatic slides and an electrohydraulic control system. Test procedures were developed and results were obtained that compare its performance with a conventional machine.
Author (NSA)

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N66-23942# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SOLID STATE RESEARCH Quarterly Technical Summary Report, 1 Aug.–31 Oct. 1965
Alan L. Mc Whorter 14 Feb. 1966 70 p refs *Its* Res. Rept.-1965-3
(Contract AF 19(628)-5167)
(ESD-TDR-65-553; AD-629048) CFSTI: HC $3.00/MF $0.75

The report covers in detail the solid state research work at Lincoln Laboratory for the period 1 August through 31 October 1965. The topics covered are Solid State Device Research, Laser Research, Materials Research, and Physics of Solids. Author (TAB)

N66-24728# General Precision, Inc., Little Falls, N. J. Research Center.
LIQUID LASER PARAMETERS Semiannual Technical Report, Aug. 1, 1965–Jan. 31, 1966
Harvey Forest, Daniel Grafstein, and Aryeh H. Samuel 28 Feb. 1966 28 p ref
(Contract Nonr-4644(00); ARPA Order 306–62; Proj. Defender)
(AD-628526) CFSTI: HC $2.60/MF $0.50

Studies were made of europium complexes of hexamethyl phosphoramide, triethyl phosphate, and tri-n-butyl phosphate, which are promising direct-excitation liquid laser materials. An overall quantum efficiency of 0.5 for fluorescence was measured. It was found that complex formation is essentially complete when the Eu concentration is below 0.2 M even when hydrated Eu salts are used. The excess of $^5D_0$ states required for laser action was calculated. A laser threshold of 6.3 watts/cm^3 per Å interval of the absorption band is calculated on the basis of these data for a 0.02 M europium complex in a 5 cm tube. Additional compounds prepared include: triethyl phosphate complexes of $SmCl_3$, $NdCl_3$, $PrCl_3$, and $TbCl_3$, which resemble the $EuCl_3$ complexes; also $EuCl_3$ complexes with triphenyl phosphate, urea, thiourea, dimethyl sulfoxide, dimethyl formamide, dimethyl acetamide, and tetramethylurea. Fluorescence in the complexes having C═O and S═O ligands is enhanced over that in aqueous Eu solutions, but not as much as in P═O complexes. The formation of precipitates from heated $EuCl_3$–alkyl phosphate complexes was further studied and a formula for the precipitate is proposed. TAB

N66-24735# Air Force Systems Command, Kirtland AFB, N. Mex. Air Force Weapons Lab.
ANGULAR DEPENDENCE OF SURFACE SCATTERED LASER RADIATION
Ronald L. Grotbeck and Glenn Doughty Jan. 1966 27 p ref
(AFWL-TR-65-220; AD-628295) CFSTI: HC $2.00/MF $0.50

Experiments to determine the relative intensity of light scattered at various angles from several materials were performed. Various target materials were mounted on an optical bench and illuminated by a Spectra Physics 116 gas laser. The targets were rotated through various angles with respect to the optical bench, and the distance between the detector and target was varied to record a constant voltage reading on a 555 oscilloscope. Different graphs showing isointensity lines for various angles of incidence as well as graphs showing the percent of intensity reflected as a function of distance were then plotted. Author (TAB)

N66-24738# California Univ., Berkeley. Dept. of Physics.
BEAM DETEORIATION AND STIMULATED RAMAN EFFECT
Y. R. Shen and Y. J. Shaham [1965] 8 p refs
(Contract Nonr-3656(32))
(AD-628074) CFSTI: HC $1.00/MF $0.50

Experimental evidence is presented to suggest that scattering mechanisms in a medium can produce inhomogeneities or filamentary structure in an initially homogeneous laser beam. It is these hot filaments which are responsible for the many anomalous effects previously observed. TAB

N66-24779# Army Electronics Labs., Fort Monmouth, N. J.
OPTIMIZATION OF THE GALLIUM ARSENIDE INJECTION LASER FOR MAXIMUM POWER OUTPUT
Juri Vilms, Lothar Wandinger, and Kenneth L. Klohn Nov. 1965 29 p refs
(ECOM-2613; AD-629426) CFSTI: HC $2.60/MF $0.50

The operating temperature of an injection laser is determined by the difference between the electrical input power and the coherent light output power, and by the details of heat conduction away from the active region. Since the efficiency of the coherent light generation is a decreasing function of temperature, a maximum exists in the curve of output versus input power. A mathematical model of the injection laser is employed to investigate how this maximum output power varies as a function of several design parameters of the injection laser. The optimum design is presented for the case of continuous operation in a 77°K environment and discuss pulsed operation of low-duty cycle in a 300°K environment. TAB

N66-24992*# Massachusetts Inst. of Tech., Cambridge. Dept. of Physics.
SATURATION BEHAVIOR OF A DOPPLER BROADENED TRANSITION INVOLVING LEVELS WITH CLOSELY SPACED STRUCTURE
H. R. Schlossberg and A. Javan [1965] 76 p refs
(Grant NsG-330)
(NASA-CR-74717) CFSTI: HC $3.00/MF $0.75 CSCL 20E

The non-linear absorption or gain characteristics of an optical frequency. Doppler broadened atomic resonance involving levels with closely spaced structure is analyzed. The level structures are assumed to be resolved with respect to their natural widths, but not necessarily with respect to the Doppler width at the optical transition. The radiation field consists of two closely spaced monochromatic frequencies lying within the Doppler width of the resonance. It is shown that, due to saturation of level populations and double quantum Raman transitions between levels, appreciable non-linear coupling exhibiting a resonance behavior takes place between the two fields. When such a resonance occurs the overall gain or attenuation characteristics of the atomic resonance change drastically. In practice the frequency spacing of the fields may be kept constant while the level structures are tuned, e.g., magnetically. The effects are analyzed for cases of running wave and standing wave radiation fields. The use of this effect in precise determination of level structures as well as mode or transition coupling of a gas laser is discussed. Portions of the analysis are applicable to resonances with more general form of inhomogeneous broadening. Author

N66-24998*# Miami Univ., Coral Gables, Fla. School of Environmental and Planetary Sciences.
LASER PROBING OF THE ATMOSPHERE Semiannual Status Report
S. Fred Singer Mar. 1966 30 p refs
(Grant NGR-10-007-028)
(NASA-CR-74730) CFSTI: HC $2.00/MF $0.50 CSCL 20E

Details are given of a proposed light backscattering experiment to probe a hypothetical layer at about or slightly above a height of 100 km. The objectives of the experiment are to investigate the implication of G. Fiocco that some particulate matter is present in the atmosphere at this altitude. Also, observations are to be extended and performed operationally for a period of at least one year in order to determine if there is a local or a seasonal character associated with Fiocco's findings. Theoretical background and system design is considered, with the laser taken as one starting point in the design of the proposed system. Consideration is given to molecular scattering by atmospheric gases since it may provide a remote measurement of atmospheric density, and also because it will tend to obscure the presence of other scatterers such as dust particles. C.T.C.

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N66-23886# David Taylor Model Basin, Washington, D. C.
EFFECTS OF TEMPERING ABOVE THE LOWER CRITICAL TEMPERATURE A_{c1} ON THE PROPERTIES OF AN HY-80 STEEL Sixth Progress Report
Abner R. Willner and Marcel L. Salive Jan. 1966 29 p refs
(DTMB-2140; AD-628979) CFSTI: HC $2.00/MF $0.50

The effects of tempering above the critical transformation temperature on the microstructure, notch-toughness and mechanical properties of HY-80 steel was investigated. The formation of alpha ferrite and prime martensite after tempering above the lower critical temperature and quenching will result in mechanical properties that fall below the requirements of the HY-80 specification. Retempering to achieve minimum yield strengths may result in nonuniform yield strength distribution. The possibility of underbead cracking due to alloy segregation is also discussed. Author (TAB)

N66-23892# ManLabs, Inc., Cambridge, Mass. Materials Research and Development.
THE LATTICE STABILITY OF METALS V. VANADIUM, CHROMIUM, COBALT AND NICKEL
Larry Kaufman Feb. 1966 25 p refs
(Contract Nonr-2600(00))
(TR-12; AD-628985) CFSTI: HC $1.00/MF $0.50

The enthalpy and entropy differences between the b.c.c., h.c.p. and f.c.c. structures of the transition elements previously estimated for second and third row transition elements have been extended to vanadium, chromium, cobalt and nickel by assuming that the stability parameters for these elements are equal to those estimated for their second and third row counterparts. The resulting free energy differences have been employed to compute eighteen binary phase diagrams between the V, Cr, Co and Ni group and other transition elements exhibiting different stable crystal structures. The computations, which are restricted to cases where miscibility gaps are absent, have been performed on the basis of ideal liquid, b.c.c., h.c.p. and f.c.c. phases in order to afford the clearest possible comparison with observed phase diagrams. Author (TAB)

N66-23917# Marine Engineering Lab., Annapolis, Md.
FEASIBILITY OF APPLICATION OF TITANIUM TO WIRE CABLE FABRICATION
Warren F. Anderson Feb. 1966 15 p
(MEL-84/66; AD-628070) CFSTI: HC $1.00/MF $0.50

The state of the art for titanium alloy wire suitable for use in wire rope fabrication is reviewed. Although many activities in and out of the Navy have indicated an interest in titanium wire rope for marine applications, no such cable is commercially available. A broad development program for titanium alloy wire and wire rope is recommended. Author (TAB)

N66-24097# Northwestern Univ., Evanston, Ill. Dept. of Materials Science.
I: ON THE MEANING OF THE FAULT PARAMETERS MEASURED BY X-RAYS. II: STRAIN DISTRIBUTIONS IN SHOCK-LOADED SINGLE CRYSTALS OF COPPER

R. J. De Angelis and J. B. Cohen 15 Feb. 1966 14 p refs (Contract Nonr-1228(20))
(TR-9; AD-628957) CFSTI: HC $1.60/MF $0.50

A comparison was made between the intensity of twin faults seen in the electron microscope and the effects on the diffraction pattern of a single crystal of copper shock-loaded at 435 kb. The Fourier coefficient of peaks like the (111), (222), (444) and (555) are effected by twin faults and that those of the (333) are not. From this fact the twin fault density can be calculated and compared with the electron microscopic results. Excellent agreement was obtained. The strain distributions in shockloaded copper was shown to be Gaussian.
Author (TAB)

N66-24236# Joint Publications Research Service, Washington, D. C.
THE QUALITY AND COST OF STEELS DI-1 AND Ei961 PRODUCED BY MELTING IN AN OPEN ELECTRIC FURNACE, IN VACUUM ARC FURNACES AND BY ELECTROSLAG REMELTING
N. T. Privalov, N. A. Tulin, B. I. Medovar, and B. I. Maksimovich *In its* Studies in Electroslag Welding 9 Mar. 1966 p 13–16 Transl. into ENGLISH from Avtomat. Svarka (Kiev), no. 9, Sep. 1965 p 77–78 (See N66-24233 13-15) CFSTI: $1.00

The cost and quality of producing flawless, heat resistant steels by vacuum arc remelting and by electroslag remelting methods were compared. The processes for the two methods are outlined, and the chemical composition of the steels is discussed. The quality of the electroslag steel was found to be equivalent to that of the vacuum arc metal. The cost of the electroslag remelting process was determined to be one third that of vacuum arc remelting, due to the lower cost of running the furnaces, the use of ac instead of dc current, and the use of rolled, etched electrodes instead of round forged ones.
N.E.N.

N66-24246# Joint Publications Research Service, Washington, D.C.
PRODUCTION OF BIMETALS [PROIZVOD STVO BIMETALLOV]
30 Mar. 1966 222 p refs Transl. into ENGLISH from Sb. Tr. Tsentr. Nauchn.-Issled. Inst. Chernoi Met. (Moscow), no. 42, 1965 p 3–132
(JPRS-34815; TT-66-31254) CFSTI: $6.00

Articles on production methods and production-related characteristics of various bimetals are presented. For individual titles see N66-24247–N66-24265.

N66-24247# Joint Publications Research Service, Washington, D.C.
PRODUCTION OF TWO-LAYER STAINLESS STEEL BY THE PACK METHOD
S. A. Golovanenko, A. A. Golovanov, L. V. Meandrov, and P. A. Skobolov *In its* Production of Bimetals 30 Mar. 1966 p 1–9 refs (See N66-24246 13-17) CFSTI: $6.00

Electroslag welding, bimetal cladding, and the pack method were compared for their advantages and shortcomings in two-layer stainless steel fabrication. Analyses of these methods and actual fabrication of bimetals led to the conclusion that expedient production of stainless steel sheets can best be conducted by the pack method and by electroslag welding. The latter method was preferable during the production of sheets thicker than 30 to 40 mm. Productivity of a pack assembly shop was determined from the volume of the output of two-layered sheets and the expenditure coefficients for processing of pack sheets; a pack assembly was then constructed that permitted the production of bimetallic sheets of 4 to 6 mm. thickness. The basic technical and economical indicies of the plant are shown.
G.G.

N66-24253# Joint Publications Research Service, Washington, D.C.
RESISTANCE OF EP375 AND EP495 ALLOYS TO DEFORMATION
B. A. Kardonov, A. F. Mel'nikov, A. V. Pravdin, and A. S. Tikhonov *In its* Production of Bimetals. 30 Mar. 1966 p 79–84 refs (See N66-24246 13-17) CFSTI: $6.00

High strength and anti-corrosion steel alloys from the nickel–chromium–molybdenum, and from the nickel–molybdenum base were evaluated for their applicability as clads in the production of bimetallic sheets by the pack method. Nickel–molybdenum based alloys displayed a 5 to 7 per cent greater resistance to hot deformation temperatures than the nickel–chromium–molybdenum based group. Temperatures below 1000° C led to structural transformation of the alloys. Rolling in the 900° to 1200° C temperature range increased deformation resistance of the alloys by 25 to 30 percent.
G.G.

N66-24255# Joint Publications Research Service, Washington, D.C.
TWO-LAYER THIN SHEET STEEL FOR THE WOODWORKING INDUSTRY
L. V. Meandrov, A. A. Bykov, Yu. V. Shilkin, S. I. Sonin, and V. V. Dus' *In its* Production of Bimetals 30 Mar. 1966 p 94–103 (See N66-24246 13-17) CFSTI: $6.00

Thin two-layer tool steel sheets, consisting of structural carbon steel clad with high alloyed tool steel, were obtained by hot rolling of welded bimetal packs. Mechanical testing of the finished sheets established the adhesive strength of the layers as 14 to 38 kg/mm^2 and their overall expenditure coefficient as 1.53. Metallographic investigation of the cohesion zone showed a sorbite-like structure with sections of thin laminar and sometimes granular perlite formations. Heat treatment improved the structure of the edge zone and the adhesive strength of the layers further.
G.G.

N66-24260# Joint Publications Research Service, Washington, D.C.
INVESTIGATION OF COHESION OF LAYERS IN HOT EXTRUDED BIMETAL
A. N. Chernov, S. A. Golovanenko, and V. V. Gulyaev *In its* Production of Bimetals 30 Mar. 1966 p 152–160 refs (See N66-24246 13-17) CFSTI: $6.00

Adhesive strengths of bimetallic steel rods, obtained by hot extrusion on a vertical hydraulic press, were evaluated by mechanical separation of the bimetal along the contact surface. Shear strength tests on crushed rods confirmed the dependency between the degree of relative reduction and the adhesive strength of the layers. Resistance to shear at 50 to 90 percent reduction approached the tensile strength value of carbon steel; an increased volume content of the cladding layer increased shear resistance noticeably. Cohesion of the layers was characterized to some degree by the microstructure of the transition layer in the bimetal; the presence of rust, dust, dirt, oil, and other impurities weakened cohesion quality. It was concluded that the adhesive strength of the layers in hot extruded bimetal rods approached the strength of the component with the lower strength limit.
G.G.

N66-24261# Joint Publications Research Service, Washington, D.C.

X-RAY MICROPROBE ANALYSIS OF THE EDGE ZONE OF BIMETAL

S. B. Maslenkov, S. A. Golovanenko, and V. A. Ustimenko *In its* Production of Bimetals 30 Mar. 1966 p 161–165 refs (See N66-24246 13-17) CFSTI: $6.00

Edge zones of bimetallic sheets made from steel–nickel and steel–Monel layers by the pack method were studied by electron microscopy. Analyses revealed a very thin diffusion layer of about 10 microns in the steel–nickel bimetal; composition of the transition layer was in the single phase region. X-ray analysis of the steel–Monel bimetal established significant diffusion of the iron into the Monel with concurrent modification of the boundary; all alloys inside 25 microns from the boundary were found to be in the two phase region. G.G.

N66-24262# Joint Publications Research Service, Washington, D. C.

INVESTIGATION OF THE MICROSTRUCTURE AND PHASE COMPOSITION OF THE DIFFUSION LAYER IN ST.3 STEEL–COPPER BIMETAL

G. A. Kokorin and V. A. Ustimenko *In its* Production of Bimetals 30 Mar. 1965 p 166–174 ref (See N66-24246 13-17) CFSTI: $6.00

Microstructure and phase composition of the diffusion layer in a steel–copper bimetal obtained by pack cladding were studied by metallographic, electron microscopic, X-ray microanalytical, and microhardness methods. It was shown that the copper in the cladding layer consisted of equiaxial grains, and the base layer of elongated alternating sections of ferrite and perlite. Quantitative determination of diffusing elements in layers adjacent to the contact surface showed that the diffusion layer consisted of solid solutions of iron in copper, and copper in iron. The copper content was 1.84 percent 2 microns from the boundary of the layer and decreased to 1.0 percent at 2.5 microns depth. Overall thickness of the diffusion layer in the bimetal was 5 to 7 microns. G.G.

N66-24263# Joint Publications Research Service, Washington, D. C.

INVESTIGATION OF THE TRANSITION LAYER IN IRON–TITANIUM BIMETAL

G. A. Kokorin and T. K. Aleksandrova *In its* Production of Bimetals 30 Mar. 1966 p 175–185 refs (See N66-24246 13-17) CFSTI: $6.00

Microstructure and phase composition of the thin transition layer that formed between the iron and titanium bimetal components during hot cladding, were studied by light microscopy, electron diffraction, electron microscopy, and X-radiation microanalysis. It was found that the diffusion layer of the iron–titanium bimetal consisted of solid solutions on the iron–titanium base. Overall thickness of the transition layer after hot cladding and annealing at 600°C for 30 minutes was four to five microns. A thin separating film of titanium nitride on the titanium–iron interface lowered the adhesive strength of the clad layer somewhat. Hot rolling in a vacuum or by the cold cladding method, prevented the formation of the separating layer between iron and titanium. G.G.

N66-24264# Joint Publications Research Service, Washington, D. C.

MECHANICAL PROPERTIES OF BIMETALS

A. L. Birulya and L. T. Timoshuk *In its* Production of Bimetals 30 Mar. 1966 p 186–196 refs (See N66-24246 13-17) CFSTI: $6.00

The mechanical properties of bimetal steel and their dependency on the thickness of the cladding layer were studied by standard tests for strength characteristics, relative elongation, tensile stress, and adhesion. Clad layer thickness increases changed most mechanical properties of the bimetal until they approached finally the characteristics of the clad layer. Disruptions of the cohesion continuity for the bimetallic specimens in the elastic and elastoplastic stage had little influence on the stress value, but decreased their longitudinal deformation. G.G.

N66-24265# Joint Publications Research Service, Washington, D. C.

NEW STANDARD FOR HOT ROLLED THICK TWO-LAYERED CORROSION RESISTANT STEEL

T. K. Aleksandrova, I. A. Balakina, and A. M. Kanunnikova *In its* Production of Bimetals 30 Mar. 1966 p 197–205 refs (See N66-24246 13-17) CFSTI: $6.00

Bimetallic sheet specimens, having a steel base layer and steel cladding, were manufactured by the pack-cladding method according to standard procedures for hot rolling. Safe layer criteria and corrosion stability were utilized to establish minimum thickness specifications for the cladding layer. Base thickness and clad layer ratios determined overall strength properties; plasticity of the base layer was checked by the flexure method with the base layer outward. It was concluded that resistance to shear did not depend on the brand of steel of the base layer, and that shear resistance along the border of the layer connections was somewhat higher than shear resistance along the base metal. A list with the obtained standard specifications for hot-rolled thick two-layered corrosion resistant bimetal steel sheets was tabulated. G.G.

N66-24267# MSA Research Corp., Callery, Pa.

MECHANICAL PROPERTIES OF MATERIALS IN SODIUM

R. C. Andrews and F. Tepper *In* AEC Proc. of Sodium Components Develop. Program Inform. Meeting, Chicago, Ill., Jun. 16–17, 1965 [1965] p 1–17 (See N66-24266 13-22) CFSTI: HC $3.00/MF $1.50

This paper discusses a research program being conducted to determine the effect of sodium on the mechanical properties of austenitic and ferritic steels. The underlying philosophy of the program is to determine if the allowable stresses, as established by mechanical property tests in air and inert gases, are adequate for the design of long time systems and equipment in sodium. The tests being used are conducted in flowing air, static helium, and flowing sodium. The tests being employed to compare the effects of the different environments include creep, creep-rupture, and fatigue, plus tensile and impact on pre-exposed and original specimens. Appropriate chemical and metallographic analyses are used in evaluating the effect of environments on the composition and microstructure of the structural alloys. The test materials are 316 stainless steel, and chromium–molybdenum steel. In addition the effects of oxygen and carbon contaminants on the mechanical properties of sodium are also being compared. R.N.A.

N66-24269# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.

IRRADIATION EFFECTS IN STAINLESS STEELS AT HIGH TEMPERATURES

W. R. Martin and J. R. Weir, Jr. *In* AEC Proc. of Sodium Components Develop. Program Inform. Meeting, Chicago, Ill., Jun. 16–17, 1965 [1965] p 36–46 refs (See N66-24266 13-22) CFSTI: HC $3.00/MF $0.50

The effect of irradiation on the elevated temperature mechanical properties of structural materials is described using type 304 stainless steel as an example. The general result is that the grain boundary fracture process, but not the deformation process, is affected. All data suggest the primary cause to be helium generated from (n,α) reactions. Several metallurgical techniques for improving the ductilities of irradiated alloys are suggested, and experimental data are given for type 304 stainless steel for which the degree of improvement is demonstrated. Author

N66-24343# Commissariat a l'Energie Atomique, Paris (France). Direction des Piles Atomiques.
STEELS FOR REACTOR VESSELS. IRRADIATION OF STEEL SAMPLES IN EL3 AT VARIOUS TEMPERATURES AND TESTING AFTER IRRADIATION [ACIERS POUR CAISSONS DE REACTEURS. IRRADIATION D'EPROUVETTES D'ACIERS DANS EL3 A DIFFERENTES TEMPERATURES ET ESSAIS APRES IRRADIATION]
M. Cibois, J. Lemaire, and M. Weisz Brussels, EURATOM, Mar. 1966 57 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-039-61-12 RDF)
(EUR-2660.f; EURAEC-1502) CFSTI: HC $3.00/MF $0.50

A study was made of the influence of the irradiation temperature on the damage sustained by various steels by using a series of six setups at temperatures rising from 100 to 400°C and doses in the region of 3.10^{19} fast neutrons. Certain properties were defined in the course of this study: For materials irradiated between 100 and 200°C, hardening generally displays a peak value which is more or less identical irrespective of the steel. The hardening subsequently declines, disappearing altogether when irradiation is performed at around 300°C. In the case of high-yield-point weldable steels, however, there is still a residual hardening even when irradiation is carried out at 400°C. Study of the cold-work curve reveals a drop in the Ky parameter of the Petch equation. This drop is much sharper in the low-carbon steels. The recovery study displays a secondary hardening effect in the manganese–molybdenum steel. Author

N66-24419# General Electric Co., San Jose, Calif.
SPECIFIC ZIRCONIUM ALLOY DESIGN PROGRAM Summary Report
H. H. Klepfer Brussels, EURATOM, 1966 99 p refs
(Contract AT (04-3)-189)
(EURATOM-2683.e; EURAEC-1193) CFSTI: HC $3.00/MF $0.75

The results of selected basic experiments gave strong indications that the corrosion and corrosion hydriding of zirconium alloys is dependent on the chemical, mechanical, and electrical properties of the oxide film. The composition of corrosion films was found to be directly proportional to the alloy content of the substrate even in complex alloys. Excellent agreement was found between the activation energy for oxygen diffusion in $ZrO_{1.994}$ and the activation energies for parabolic or cubic oxidation of zirconium in both air and water. Yttrium decreased the plasticity of zirconium oxide while chromium and iron increased plasticity, and thus accounted for the early spalling of oxide observed for Zr–Y alloys and the good adherence of films on Zr–Cr and Zr–Fe alloys. Corrosion hydriding may be controlled by whether electronic, or protonic, charge transport is promoted by the addition of a given alloying element to the zirconium oxide film. Corrosion rates, hydriding rates, and mechanical properties of 31 alloys containing selected additions of Nb, Cr, Fe, or Cu were measured at 300, 400, and 500°C. Author

N66-24476# Brush Beryllium Co., Cleveland, Ohio.
THE EFFECT OF $AlFeBe_4$ ON MECHANICAL PROPERTIES OF FABRICATED POLYCRYSTALLINE BERYLLIUM
J. A. Carrabine, D. H. Woodard, A. J. Stonehouse, and W. W. Beaver [1964] 23 p refs Presented at the Intern. Conf. on Beryllium Met. and Technol., Philadelphia, Oct. 1964
(TR-368)

The effects of the $AlFeBe_4$ precipitation reaction on the mechanical properties of polycrystalline beryllium were evaluated at room and elevated temperatures up to 566°C. Specimens were tested in aged and solutionized conditions, as well as in the as-wrought metal state. Room-temperature ductility tests showed no consistent dependence on the phase behavior; however, elevated temperatures varied considerably with the percentage of the iron and aluminum contents in the samples. Optimum ductilities corresponded to iron/aluminum weight ratios of two or greater and/or low aluminum contents. Aging generally lowered the strength properties at all temperatures, had little effect on room-temperature ductility, but increased elevated-temperature ductility in all specimens. It was concluded that the $AlFeBe_4$ reaction was reversible and showed reasonable evidence for iron being in solid solution. G.G.

N66-24478# Joint Publications Research Service, Washington, D. C.
METALLIDES AND REACTIONS AMONG THEM
I. I. Kornilov 29 Mar. 1966 245 p refs Transl. into ENGLISH of a book "Metallidy i Vzaimodeystviye Mezhdu Nimi" Moscow, 1964 p 1–181
(JRPS-34774; TT-66-31213) CFSTI: $6.00

The formation of metal compounds, with the exception of compounds with an ionic bound, was studied for their physical and chemical properties. Observed were the electronic structure of their atoms, ratios of the atomic radii, and the electronegativity and ionization potentials of the elements depending on their mutual position in the periodic system. A classification of the various metalloides by chemical bond was obtained, and interconversions of bond types from metallic to ionic, as well as the presence of intermediate and mixed bond types in various compounds of metals were demonstrated. Also included in this monograph was a theory of interaction of metalloides. Various applications of metalloides and their alloys were also described. G.G.

N66-24488*# Syracuse Univ. Research Inst., N.Y. Dept. of Chemical Engineering and Metallurgy.
MATERIALS DATA HANDBOOK—ALUMINUM ALLOY 2219
John Sessler and Volker Weiss, ed. Mar. 1965 185 p refs
(Contract NAS8-11345)
(NASA-CR-74545) CFSTI: HC $5.00/MF $0.75 CSCL 11F

A materials data handbook on aluminum alloy 2219 covering all of the information on the materials properties presently available, is presented. The scope of the information includes physical and mechanical property data at cryogenic, ambient, and elevated temperatures, supplemented by information in such areas as material procurement, metallurgy of the alloy, corrosion, environmental effects, fabrication, and joining techniques. Design data are presented, where available, and these data are complemented with information on the typical behavior of the alloy. Numerous tables and illustrations are given, along with the descriptive text. L.S.

N66-24552# Bureau of Mines, Reno, Nev.
CONSOLIDATION AND MECHANICAL PROPERTIES OF ELECTROWON MOLYBDENUM

Edward A. Loria and J. M. Kees 1966 24 p refs
(BM-RI-6771)

High-quality sheet of electrowon molybdenum was attained by a sequence of procedure on pressed and arc-melted crystalline powders. The procedures included high-temperature, high-vacuum sintering treatments and the use of metal deoxidizers instead of carbon to improve the mechanical properties of the molybdenum sheet. Rolled sheet 60 mils thick was evaluated by tensile and bend tests, hardness measurements, microstructures, and recrystallization treatments. After stress relieving, yield strength ranged from 85,000 to 110,500 psi (0.2 percent offset) and ultimate strength ranged from 87,200 to 117,250 psi with 4.5 to 25 percent elongation observed for arc-melted sheet, and 5.0 to 23 percent elongation observed for powder metallurgy sheet. In room temperature bend tests the sheet yielded plastically, indicating that the ductile–brittle transition point was below room temperature. The diamond pyramid hardness (DPH) of the molybdenum sheet changed from 214 to 293 DPH for the stress-relieved condition to 177 to 185 DPH for the fully recrystallized condition. The brittleness of recrystallized molybdenum, reported by other investigators as characteristic of sheet prepared from commercial-grade hydrogen-reduced powders, was not in evidence. Recrystallized tensile specimens pulled at room temperature had an average elongation of 31 percent. Author

N66-24563# Bureau of Mines, Albany, Oreg.
IMPROVEMENT OF A COMMERCIAL HYPEREUTECTIC ALUMINUM-SILICON MASTER ALLOY
R. R. Lowery, J. G. Croeni, and H. Kato 1966 33 p refs
(BM-RI-6765)

The Bureau of Mines developed hypereutectic aluminum–silicon alloys which had better mechanical properties than the unmodified hypereutectic alloy. A commercial aluminum–20 weight-percent–silicon master alloy was selected as a binary base for improvement. The primary silicon grains were reduced from ASTM 4.5 to ASTM 8.5 by the use of phosphorus and phosphorus compounds. The remaining eutectic matrix was refined by sodium metal additions of 0.2 weight-percent. So d solution strengthening of the alpha aluminum was obtained by adding 2 percent copper and 0.5 percent magnesium. Also, 1 percent nickel was added to harden the alloy. Optimum thermal treatment consisted of a solution treatment for 10 hours at 480°C with hot water quench, followed by aging for 6 hours at 175°C. The final alloy exhibited a Rockwell B hardness of 75±2 in the heat-treated condition. The ultimate tensile strength was 39,500 psi with no recordable elongation. The coefficient of linear thermal expansion was 20.4×10^{-6} per °C in the temperature range 20° to 300°C. No wear resistance data were collected. Author

N66-24564# Library of Congress, Washington, D. C. Aerospace Technology Div.
HIGH-PURITY METALS, PART II Surveys of Communist World Scientific and Technical Literature
Alex Zurichenko 16 Feb. 1966 30 p refs Annotated bibliography
(ATD-66-17)

This annotated bibliography was compiled from Soviet-Satellite open sources published 1964–1965. The entries are arranged chronologically and divided into two parts by year: Part A (1964) comprises 31 entries and Part B (1965) includes 40 entries. References are included on: zinc, electron paramagnetic resonance, single crystal growing, chemiluminescence, lithium, boron, selenide, mechanical heat treatment, arsenic, tantalum, graphite, bismuth, cesium, rhenium, mercury, iron, vacuum furnace, induction furnace, lead, indium, zone recrystallization, vanadium compound, gallium, manganese, titanium, beryllium, cerium, single crystal, boron compound, sulfur, uranium, vacuum refining, yttrium, molybdenum, gold, semiconducting material, electrolytic refining, thallium, phosphorus, silicon, antimony, tin. Author

N66-24565# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
TITANIUM CORROSION IN AQUEOUS SOLUTIONS
Sam M. Weiman Feb. 1965 40 p refs Submitted for Publication *Its* Eng. Paper No. 1799

Experimental results on the corrosion behavior of titanium in aqueous solutions are reported. A corrosion mechanism is based on the capability of achieving and maintaining a critical tetravalent titanium ion equilibrium concentration, $[Ti^{+4}]_c$. The corrosion film appears to play a part in this model. It is considered that the film may occur in two forms, one of which is soluble and the other is not. The soluble form is thought to be in equilibrium with $[Ti^{+4}]_c$ and thus contribute to the apparent corrosion resistance of the system as well as to explain some of the experimental results. A discussion of the implications, including practical applications of this mechanism, is presented. Author

N66-24585*# Martin Co., Denver, Colo. Welding Research and Development.
ANALYTICAL AND STATISTICAL STUDY ON THE EFFECTS OF POROSITY LEVEL ON WELD JOINT PERFORMANCE Technical Summary Report, 1 Jul. 1964–29 Mar. 1966
Edward J. Rupert and John F. Rudy Mar. 1966 343 p refs (Contract NAS8-11335)
(NASA-CR-74595; CR-66-15) CFSTI: HC $7.00/MF $1.75 CSCL 11F

This experimental program considered the effects of porosity in 2014 and 2219 aluminum alloys. DC TIG welds, developed by the contamination of helium shield gas by the addition of metered amounts of hydrogen, moisture-saturated helium, or a combination of both. Porosity, from .005 inch to .200 inch diameter, was developed in a continuous type pattern in 24 inch long welds. Welds were made in the flat, horizontal and vertical positions on 1/4 inch and 3/4 inch thick material. Fracture pore rating and radiographic pore concentration determinations were made and related to mechanical properties in the transverse and longitudinal axis for the bead-on and bead-removed condition. Increasing percentage of porosity in a weld reduces strength; fine porosity of 1/64th size, present in sufficient numbers to contribute a total area comparable to large pores, appears to effect the loss in strength as much as do large pores. Longitudinal axis tests indicate a less significant effect of porosity when some heat affected metal is permitted in the cross-section. Data are also given for the loss in fatigue strength-life with increasing porosity. Author

N66-24646# United States Steel Corp., Pittsburgh, Pa.
LOW TEMPERATURE AND CRYOGENIC STEELS MATERIALS MANUAL
[1965] 104 p refs
(ADUSS-01-1206)

Information is provided on the family of steels produced for use in low temperature and cryogenic service. Included

are synopses of material properties and fabrication techniques, as well as an evaluation of containers and other criteria required when designing cryogenic process equipment. Also, a method is described for a comparative economic analysis to establish the most efficient metal for a given cryogenic container. D.T.

N66-24695*# Lockheed-Georgia Co., Marietta.
EFFECT OF NUCLEAR RADIATION ON MATERIALS AT CRYOGENIC TEMPERATURES Final Report
C. A. Schwanbeck Jan. 1965 303 p
(Contracts NAS3-7987; NASw-114)
(NASA-CR-54881; LAC-ER-8434) CFSTI: HC $7.00/MF $1.75 CSCL 11F

The tensile testing was performed at room temperature without irradiation, at 30°R without irradiation, and at 30°R in a high flux zone of a nuclear reactor after 1×10^{17} nvt (E>0.5 Mev) at the same temperature. The irradiation times varied from 11 to 17 hours. The properties that were measured were the yield strength, the ultimate strength, the elongation, the reduction of area and, in some materials, the notched ultimate strength. Aluminum 1099 (−H14) showed previously unreported reduction in tensile yield strength at 30°R unirradiated which was fully recovered with irradiation. The heat treatable high copper aluminum alloys and the aluminum–magnesium silicon alloy 6061 show a consistent reduction of ultimate strength due to irradiation at 30°R. The high magnesium–low zinc aluminum alloys gave no indication of serious deterioration of mechanical properties. The titanium alloys exhibited similar cryogenic and irradiation effects. The nickel alloys, René 41 and Inconel X, show significant decreases in notch strength, which K-Monel shows an increase in yield strength and Inconel shows an increase in notch strength. The cryogenic and nuclear cryogenic effects in the austenitic stainless steels appear to be a function of the austenitic stability. Author

N66-24717# Watervliet Arsenal, N. Y. Benet Labs.
THE RECOVERY OF THE ULTRASONIC ATTENUATION IN COPPER SINGLE CRYSTALS FOLLOWING SMALL PLASTIC DEFORMATION
Julius Frankel Dec. 1965 46 p refs
(WVT-6533; AD-628939) CFSTI: HC $1.25/MF $0.50

Copper single crystals of 99.9% purity were deformed about .5% in tension at temperatures in the range 332.5° to 368° K. The ultrasonic attenuation was measured continuously after deformation at a frequency of about 17Mc. During the measurement the specimen was in the load-off condition and at the deformation temperature. It is found by use of the Granato, Hikata and Lucke recovery theory, that the Cottrell-Bilby $t^{2/3}$ strain aging law is obeyed in the recovery of the ultrasonic attenuation. In most cases the use of an incubation time is required which differentiates between the time the deformation stopped and the time at which the $t^{2/3}$ law seems to take effect. The recovery parameters for the three low temperature runs plotted against 1/kT yield 1.0 ±0.2 ev as the activation energy for migration of the deformation-formed defect. The defect is therefore identified as the vacancy. It was possible to determine the approximate time after deformation stopped for which the pinning point density on the dislocations is a maximum. These times can be correlated with the times obtained by Birnbaum's low temperature strain-aging technique. Author (TAB)

N66-24732# Wisconsin Univ., Madison.
MECHANISM OF STRESS CORROSION CRACKING IN FACE-CENTERED-CUBIC METALS Final Technical Report
R. A. Dodd [1965] 5 p refs
(Grant AF-AFOSR-221-63)
(AFOSR-65-2702; AD-628085) CFSTI: HC $1.00/MF $0.50

The work was designed firstly to examine the possibility of the existence of a universal mechanism of transgranular stress corrosion cracking, originally postulated by Robertson and Tetelman, and later, when such a mechanism was substantially disproved, to examine possible cracking mechanisms in various alloy systems of interest. The experimental techniques employed included the determination of times to complete fracture under stress corrosion conditions, potentiostatic studies of polarization phenomena, etc., and electron microscope investigations of dislocation configurations and estimates of the related stacking fault energies. TAB

N66-24743# Colorado School of Mines, Golden.
THE MECHANICAL PROPERTIES OF COPPER AT HIGH STRAIN RATES. VOLUME I: THE EFFECT OF STRAIN RATE ON THE FLOW STRESS OF COPPER
J. D. Lubahn, R. C. Culver, and R. L. Straw Kirtland AFB, N. Mex., AFWL, Feb. 1966 48 p refs
(Contract AF 29(601)-6042)
(AFWL-TR-65-121, v. I; AD-628865) CFSTI: HC $2.00/MF $0.50

An experimental method of determining dynamic flow stress where the stress is homogeneous is developed using a pendulum bar suspension system. A small specimen is mounted on the end of one of the bars and the other bar is impacted on the free end of the specimen. For copper, the dynamic stress is 29% larger than the static stress for a strain rate of about 100 sec^{-1} (or an increase in strain rate of about 5 orders of magnitude). For various tests, the increase in dynamic stress over the static value varied from 17% to 45%. This variation is comparable with the expected scatter for a typical test (±10%) predicted from the uncertainties in measurement. Author (TAB)

N66-24777# Naval Ordnance Lab., White Oak, Md. Explosions Research Dept.
THE EXISTENCE AND IMPLICATIONS OF CURVATURE IN THE RELATION BETWEEN SHOCK AND PARTICLE VELOCITIES FOR METALS
D. John Pastine and D. Piacesi Apr. 1966 27 p refs
(NOLTR-65-233; AD-629428) CFSTI: HC $2.60/MF $0.50

Evidence is presented for the existence of curvature in the relation between shock velocity (U) and particle velocity (u) for metals. Existing U,u data is fit to an expansion of the form $U = C_b + b_1 u + b_2/2 u^2$ where C_b is the bulk sound speed at zero pressure. The slopes b_1 thus calculated are shown to agree well with the slopes b_1 predicted on the basis of low pressure ultrasonic data. In addition, possibility of estimating the U,u relation from low pressure data is demonstrated. Author (TAB)

N66-24784# Colorado School of Mines Research Foundation, Inc., Golden.
THE MECHANICAL PROPERTIES OF COPPER AT HIGH STRAIN RATES. VOLUME II: ANALYTICAL AND EXPERIMENTAL PLASTIC STRAIN PROFILES IN HIGH VELOCITY IMPACT Technical Report, 1 May 1963–28 Feb. 1965
J. D. Lubahn and R. A. Houidobre Kirtland AFB, N. Mex., AF Weapons Lab., Feb. 1966 113 p refs
(Contract AF 29(601)-6042)
(AFWL-TR-65-121, Vol. II; AD-628977) CFSTI: HC $11.60/MF $0.75

Cold-drawn copper rods were end-impacted with projectiles having lengths of 1 to 5 inches and initial velocities of 500 to 1240 in./sec, and the resulting plastic strain profiles were measured. Also the strain profiles were calculated using a numerical method based on the method of characteristics and on material properties which are rate sensitive. The reliability of the concepts employed in these calculations was indicated by the good agreement between the measurement and calculated strain profiles. Strain rate exponent, defined as the slope of the curve of log stresses versus log plastic strain rate, was found by these calculations to increase with increasing strain rate, reaching a value of about 0.04 at a plastic strain rate, reaching a value of about 0.04 at a plastic strain rate of 400/sec. Author (TAB)

N66-24801# Ballistic Research Labs., Aberdeen Proving Ground, Md.

A METALLURGICAL STUDY OF HIGH STRAIN RATE DEFORMATION

Coy M. Glass, Stanley K. Golaski, John J. Misey, and Gerald L. Moss Kirtland AFB, N. Mex., AF Weapons Lab., Mar. 1966 57 p refs

(AFWL-TR-66-7; AD-629921) CFSTI: HC $3.00/MF $0.75

A systematic study was carried out on the failure of metals subjected to explosive loading. A longitudinal shock wave is passed through a cylindrical specimen which is press fit into a specimen holder of like material. The compressive wave is reflected from the free surface and the specimen is subjected to a tensile load which causes it to fail. It is interesting to note that at pressures several times the static strength of the material, the failure mode is similar to that obtained during static loading, i.e., a necking-down of the specimen and a resultant cup-cone type fracture. Investigations have been carried out for the following materials: high purity copper, 1100°F aluminum, Armco iron, 1020, 1045, 4140 steels, and 304 stainless steel. Single crystals and polycrystalline specimen have been compared for copper. The experimental and analytical results reported are: (1) fracture times as a function of pressure; (2) shear wave velocities generated in the specimen; (3) dynamic theoretical strengths of metals; (4) the effect of size (diameter) of the specimen on its dynamic strength; (5) the influence of internal boundaries on the formation of shear waves. Theoretical treatment of the data shown that the results obtained may be explained by extending Truesdale's analysis on the propagation of an elastic wave in a pre-compressed media, and the use of the Baker–Ericson inequality for waves at a boundary. Author (TAB)

N66-24843# Marquardt Corp., Van Nuys, Calif.

MARQUARDT MATERIALS RESEARCH ACTIVITIES, 1963–1965

B. A. Webb Apr. 1965 27 p refs Presented at the Refractory Composites Working Group 10th Natl. Meeting, Atlanta

(Contracts AF 33(657)-12146; AF 33(615)-1628)

(MR-20323)

This report describes a materials research program concerned with developing high temperature oxidation resistant materials for use in ramjet and rocket propulsion systems. Emphasis has been on the development of coating systems for graphite and the refractory metals needed for such structural components as combustion chambers, nozzles, and inlet leading edges; and more specifically, coating systems for use above 3000°F. Research on an oxidation and erosion resistant coating for graphite resulted in the development of a vapor deposited silicon carbide which was extensively evaluated in liquid rocket thrust chambers with considerable success. Coating systems research for refractory metals led to the development of a ductile hafnium–tantalum based alloy which appears promising for use up to 4000°F. Investigations were also conducted on high strength high modulus filaments for use in reinforced composites. This effort was based on the vapor deposition studies with silicon carbide. R.N.A.

N66-24849# General Electric Co., Philadelphia, Pa. Missile and Space Div.

ROLE OF THE INTERFACE IN METAL–CERAMIC (WHISKER) COMPOSITES

Willard H. Sutton Feb. 1966 32 p refs Presented at the Ann. Meeting of the Soc. of the Plastics Ind., Chicago, Feb. 1966

(Contracts NOw-60-0465-d; DA-36-034-ORD-3768(Z))

(R66SD4; AD-477422)

The strengthening of metals by whiskers is based on the fact that the metal matrix must be capable of distributing an applied load among the individual whiskers. The interface plays a major role in transferring this load from the matrix to the whiskers, and thus is of critical importance to the strength of the composite. In addition to the mechanical requirements that the interface must satisfy, there are also chemical requirements which deal with the wetting, the bonding and the reactions/diffusion occurring between the whiskers and matrix. The importance of the mechanical and chemical requirements are discussed, and are illustrated by the results of studies on experimental composites of silver reinforced with Al_2O_3 whiskers. Author (TAB)

N66-24866# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.

AN INVESTIGATION OF THE PROPERTIES OF BERYLLIA CONTAINING UP TO 15w/o SILICON CARBIDE AND UP TO 2w/o MAGNESIA

N. A. Hill, J. S. O'Neill, and D. T. Livey Jan. 1966 22 p refs

(AERE-R-5056)

A dispersion of sub-micron size silicon carbide particles in beryllia containing 1w/o MgO was found to restrict grain growth during sintering. Compacts containing 8w/o SiC sintered to a density of 2.94 g/cc. after 4 h at 1750°C with a mean grain diameter of 5μ and a mean modulus of rupture in 3 point bending of 50,000 p.s.i. The mean modulus of rupture was approximately proportional to the reciprocal of the square root of mean grain diameter. These results are compared with those from beryllia without additions. Author

N66-24874# British Non-Ferrous Metals Research Association, London (England).

THE MECHANISM OF BREAKAWAY OXIDATION IN ZIRCONIUM ALLOYS

J. C. Greenbank and S. Harper Risley, England, Atomic Energy Authority, 19 Jan. 1966 18 p refs Presented at Symp. on Zirconium and its Alloys, Buffalo, Oct. 1965 Submitted for Publication

(TRG-1174(C/X))

The oxide films formed on several zirconium alloys in a variety of oxidizing atmospheres have been studied in both pre- and post-breakaway conditions. It is suggested that breakaway occurs due to the mechanical failure of the oxide film, the stresses generated in the growing film being such that in post-breakaway conditions the outer layer of oxide is cracked progressively deeper, while the rate of oxidation is controlled by diffusion through the innermost uncracked oxide layer which remains of constant thickness. Author

N66-24897# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
A NEUTRON DIFFRACTION INVESTIGATION OF SOME IRON-TUNGSTEN CARBIDES [NEUTRONOGRAFICZNE BADANIE NIEKTORYCH WEGLIKOW ZELAZOWO-WOLFRAMOWYCH]
Zbigniew Bojarski (Inst. of Ferrous Metallurgy, Gliwice) and Janusz Leciejfwicz Nov. 1965 19 p refs
(INR-665/II/PS) CFSTI: HC $1.00/MF $0.50

The crystal structures of two carbides with the composition Fe_3W_3C and Fe_6W_6C occurring in the ternary system Fe-W-C were redetermined by neutron diffraction. The atomic parameters were refined by the method of least-squares using a computer. A detailed discussion of the crystal structures of both phases is presented. Author

N66-24899# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
SOME PROPERTIES OF U-Mo 1% WT. ALLOY AFTER THERMAL TREATMENT [NIEKTORE WLASNOSCI OBROBIONEGO CIEPLNIE STOPU U-MO 1% CIEZ.]
A. Hofman May 1965 17 p refs In POLISH; ENGLISH summary
(INR-645/XIV/PS) CFSTI: HC $1.00/MF $0.50

The influence of thermal treatment on the structure and the mechanical properties of U-Mo1% wt. has investigated. The behavior of this alloy under thermal cycling was examined. The experiments showed, that using an appropriate thermal treatment the required structure $\alpha+\gamma$ of the alloys can be obtained. The addition of the molybdenum improved the mechanical properties and dimensional stability of the alloy under cyclic temperature changes. Author

N66-24914*# National Aeronautics and Space Administration, Washington, D.C.
DETERMINATION OF THE SURFACE STATE OF METAL POWDER PARTICLES BY SCATTERING OF LIGHT [OPREDELENIYE SOSTOYANIYA POVERKHNOSTI METALLICHESKIKH POROSHKOVYKH CHASTITS PO RASSEYANIYU SVETA]
A. I. Raychenko Apr. 1966 15 p refs Transl. into ENGLISH from Poroshkovaya Met., Akad. Nauk Ukr. SSR (Kiev), v. 33, no. 9, 1965 p 69-75
(NASA-TT-F-10086) CFSTI: HC $1.00/MF $0.50 CSCL 11F

Quantitative characteristics of the degree of roughness of metal powder particles, assumed to be convex and of equal disperseness, determined from the scattering of light of wavelength shorter than the size of surface irregularities are derived, with formulas for the scattering indicatrices in diffraction, reflection, and absorption. The diffraction part of the scattering is used as dispersity control of the investigated particles. Author

N66-25004*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
COMPATIBILITY OF COLUMBIUM AND TANTALUM TUBING ALLOYS WITH REFLUXING POTASSIUM
Coulson M. Scheuermann and Charles A. Barrett Washington, NASA, May 1966 45 p refs
(NASA-TN-D-3429) CFSTI: HC $2.00/MF $0.50 CSCL 11F

The corrosion resistance of potential columbium and tantalum tubing alloys to refluxing potassium was tested at temperatures bracketing the maximum expected use temperature of the advanced turboelectric space power systems, 1800° to 2400°F. Tests were conducted with reflux capsules. The capsule wall served as the test specimen. The initial oxygen content of the potassium was a maximum of 20 parts per million as determined by mercury amalgamation and vacuum distillation techniques. The oxygen content of the materials was generally 100 to 200 parts per million. The tests were performed in a vacuum of 10^{-7} to 10^{-8} torr for times up to 4000 hours. The materials studied were the columbium alloys B-33, SCb-291, Cb-1Zr, D-14, B-66, FS-85, AS-55, D-43, C-129, and Cb-752; and the tantalum alloys Ta-10W, T-111, and T-222. The gettered alloys containing the reactive elements zirconium or hafnium were found to be more resistent to corrosive attack than the ungettered alloys under the test conditions. A mechanism is proposed, based on experimental results, that describes the oxygen accelerated corrosive attack of columbium and columbium alloys by potassium under refluxing conditions, involving the formation and solution of complex oxides. This mechanism may be expected to be applicable, in principle, to the other refractory metal-alkali metal systems as well. Author

N66-25005*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
ACCELERATED CAVITATION DAMAGE OF STEELS AND SUPERALLOYS IN LIQUID METALS
Stanley G. Young and James R. Johnston Washington, NASA, May 1966 43 p refs
(NASA-TN-D-3426) CFSTI: HC $2.00/MF $0.50 CSCL 11F

Cavitation damage in liquid metal environments of materials under consideration for components of liquid metal power conversion systems was studied. The materials investigated included AISI-316 and 316 stainless steels, Sicromo 9M, Inconel 600, A-286, Hastelloy X, L-605, René-41, and Stellite 6B. A magnetostrictive apparatus was used to perform accelerated cavitation damage tests with liquid sodium at 800°F and mercury at 300°F. Cavitation damage determined by volume loss and surface roughness measurements was used to rank the various materials, and to compare the effects of the different fluids on the degree of damage sustained. Metallographic studies were made to determine the nature of the early stages of cavitation damage. The materials tested in both sodium and mercury ranked in the same order of resistance to cavitation damage, but the degree of damage to all materials was consistently greater when tested in mercury. The most resistant material by far was Stellite 6B; the least resistant material was annealed Sicromo 9M. Surface roughness measurements were found to provide the same ranking of materials as that provided by conventional volume loss measurements. Visual observation of sodium pump impeller blades of three materials operated under cavitating conditions for 250 hours indicated the same ranking of the materials with respect to resistance to cavitation damage that was determined from the accelerated cavitation tests. Author

N66-25072# Rensselaer Polytechnic Inst., Troy, N. Y.
PRECIPITATION PHENOMENA IN CERAMICS: THE SYSTEM $BaTiO_3$—$CaTiO_3$ Final Report
Robert C. De Vries, George S. Ansell, Francis W. Cooke, and Richard C. Bradt 30 Nov. 1965 27 p refs
(Contract AT(30-1)-3176)
(RPI-3176-1) CFSTI: HC $2.00/MF $0.50

The effect of a dispersed second phase on the ferroelectric domain structure of $BaTiO_3$ was investigated and these effects correlated with changes in dielectric aging behavior. The dispersion was achieved by precipitating a $CaTiO_3$-rich solid solution from an initially homogeneous polycrystalline $BaTiO_3$-20

wt% $CaTiO_3$ solid solution. It was observed that the 90° domains became quite irregular in shape and decreased in thickness by an order of magnitude, from 0.2 to 0.03μ when 20 wt % $CaTiO_3$ was added in solid solution to the $BaTiO_3$. The domain structure was only slightly coarser and more regular in solid solution single crystals, but the 90° domains become organized into bands similar to those observed in pure $BaTiO_3$ single crystals. Thus the thickness and regularity of the 90° domains is dependent on alloy content as well as on the strains inherent in polycrystallinr $BaTiO_3$, while the banding behavior seems sensitive mainly to the strains. The precipitation heat treatments produced up to 7 vol % second phase at 1200°C with particle sizes up to 40μ. Below 1000°C only a fraction of a percent of second phase was produced in the form of spherical particles with sizes down to less than 0.05μ and a mean free path between particles of about 0.5 μ. The most unusual and significant result of this microstructure study was that no morphologically related precipitate could be produced by any heat treatment, despite the structural similarity of the phases involved. The temperature dependence of the aging rate for $BaTiO_3$–$CaTiO_3$ alloys is just the reverse of that for unalloyed $BaTiO_3$, indicating that aging is not simply a thermally activated process. The presence of second phase particles with a dispersion comparable to the size of the 90° domains has no observable effect on aging behavior, but as the composition of the alpha phase approaches that of pure $BaTiO_3$, the aging behavior also becomes more like that of pure $BaTiO_3$. Author (NSA)

N66-25091# California Univ., Livermore. Lawrence Radiation Lab.
THE EFFECT OF IMPURITY AND FOREST DISLOCATIONS ON THE FLOW STRESS OF COPPER
P. C. J. Gallagher Aug. 1965 36 p refs Presented at Conf. on Lattice Defects, Honolulu, Hawaii
(Contract W-7405-ENG-48)
(UCRL-16374; CONF-650956-2) CFSTI: HC $2.00/MF $0.50

Studies were made on the relative magnitudes of τ_s, short range, thermally activable part of the flow stress, and of τ_g, long range stress, for copper single crystals at room temperature. Known impurity contents and dislocation distributions were introduced to the crystals. By identifying the values of τ_s/τ_g characteristic of impurity-dislocation, and of forest-primary dislocation interactions it was possible to establish the regions of the stress-strain in which these reactions play an important role. Evidence exists for the effect of impurity on both τ_s and the total flow stress at low stresses. A strain rate change by a factor of 10 led to a stress increment $\Delta\tau_s$, which is proportional to τ_s. The results also afforded detailed data on the variation of $V\tau$ with stress (V is the apparent activation volume), and the applicability of the Cottrell–Stokes Law. NSA

N66-25093# Battelle-Northwest, Richland, Wash. Ceramics Research and Development Section.
COMPATIBILITY BETWEEN PuO_2 AND Ni/20 Cr
D. F. Carroll 29 Jan. 1965 29 p refs
(Contracts AT(45-1)-1350; AT(45-1)-1830)
(BNWL-18) CFSTI: HC $2.00/MF $0.50

PuO_2 was found to be compatible with an alloy of 80 Ni–20 Cr at 1093°C for 400 hrs. The oxidation stability of a PuO_2–62 wt% (Ni–20 Cr) cermet heated in air to 1093°C is superior to that of a UO_2–62 wt % (Ni–20 Cr) cermet. UO_2, if not protected by cladding, is converted to U_3O_8 in 982°C air even though it is dispersed and impacted in the Ni–20 Cr alloy. The PuO_2 cermet can be diffusion bonded to Ni–20 Cr foil by pneumatic impaction at 1093°C and ~250,000 psi. The compatibility of PuO_2 with Ni–20 Cr cladding material is dependent on the Si content of the alloy. PuO_2 reacts with Si in the foil at 816°C. No evidence of PuO_2 diffusion through a 0.15 mm thick alloy foil was found after heating at 1093°C for as long as 400 hrs. Author (NSA)

N66-25094# Bettis Atomic Power Lab., Pittsburgh, Pa.
DEVELOPMENT OF ZIRCONIUM-BASE ALLOYS
W. F. Bourgeois and J. N. Chirigos Nov. 1965 44 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-546) CFSTI: HC $2.00/MF $0.50

An experimental program was conducted in order to develop an alloy having corrosion resistance superior to Zircaloy-2 in steam at temperatures greater than 750°F but with hydrogen pickup and corrosion resistance in water at least equal to that of Zircaloy-2. Corrosion results, hydrogen absorption, hardness, and some tensile data are presented for six zirconium-base alloys containing from 0 to 1 wt% tin, iron, and chromium after 311 days in 680°F water, 259 days in 850°F steam (1500 psi), 176 days in 950°F steam (1500 psi), and 30 days in 1150°F steam (15 psi). It was concluded that four alloys are particularly promising for high-temperature steam applications and, of these, a ternary alloy of sponge zirconium with 0.5 wt% iron and 1.0 wt% chromium appears to have the best combination of overall properties.
Author (NSA)

N66-25095# Pittsburgh Univ., Pa.
THE EFFECTS OF OXYGEN ON SOME PROPERTIES OF HAFNIUM
James G. Goodwin (M.S. Thesis) 1965 53 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-T-1683) CFSTI: HC $3.00/MF $0.50

The effects of oxygen on the hot and cold fabricability, hardness, recrystallization, tensile properties, weldability, impact strength, and corrosion resistance of hafnium were investigated. Oxygen contents over a range of about 50 to 1500 ppM were used. It was determined that homogeneous alloys of hafnium and oxygen can be melted and that these alloys can be successfully hot- and cold-fabricated into strip. The hardness of the HF–O alloys behaved as anticipated, increasing with increasing oxygen. Hot hardness measurements showed the strengthening effect of oxygen to exist at 1470°F. In the range of oxygen content studied, oxygen did not affect the recrystallization temperature. However, oxygen caused a substantial increase in the yield and ultimate strength of Hf up to 600°F Corrosion tests in water at 680°F and steam at 750 and 850°F revealed no effects of oxygen on the corrosion rate of Hf. It was concluded that the oxygen content of Hf for production should be specified as the range of 100 to 400 ppM. NSA

N66-25103# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
FRACTURE TOUGHNESS TESTS ON A302B STEEL
A. J. Bush and R. B. Stouffer Oct. 1965 60 p refs
(Contract AT(30-1)-3108)
(WERL-8844-9) CFSTI: HC $3.00/MF $0.75

Results of tests using Wedge Opening Loading specimens are given. Two sample sizes were used, 1X and 2X, in both the as-received and annealed conditions. The tests were conducted in the temperature range of −320° to 300°F. NSA

N66-25118# Iowa State Univ. of Science and Technology, Ames. Ames Lab.
A NUCLEAR MAGNETIC RESONANCE STUDY OF Sc^{45} HYPERFINE INTERACTIONS IN SCANDIUM-RICH Sc–Y, Sc–Zr, AND Sc–Gd ALLOYS
Bruce Ronald Mc Cart (Ph.D. Thesis) Nov. 1965 134 p refs
(Contract W-7405-ENG-82)
(IS-T-38) CFSTI: HC $4.00/MF $1.00

The nuclear magnetic resonance of ^{45}Sc was studied in a series of scandium-rich solid solution alloys in the Sc–Y, Sc–Zr, and Sc–Gd alloy systems. For each alloy studied, values were found for three hyperfine interaction parameters: the isotropic Knight shift, the anisotropic Knight shift, and the electric quadrupole coupling constant. The isotropic and anisotropic Knight shift results for the Sc–Y alloys indicate that the addition of yttrium causes a change in the electrons at the Fermi surface from s-character to d-character. The isotropic Knight shift decreases in proportion to the decrease in the density of electron states at the Fermi surface for the Sc–Zr alloys. The anisotropic Knight shift changes in an anomalous manner which is unexplained as yet for the alloys in the Sc–Zr system. The isotropic Knight shift of the ^{45}Sc nmr line decreases with the addition of gadolinium. The anisotropic Knight shift appears to increase rapidly in magnitude in the Sc–Gd alloys. It was concluded that the electric field gradient of the conduction electrons and that of the ion lattice have the same sign. NSA

N66-25140# California Univ., Livermore. Lawrence Radiation Lab.
SOME OBSERVATIONS ON THE COMPRESSIVE CREEP BEHAVIOR OF A DELTA STABILIZED PLUTONIUM-1 w/o GALLIUM ALLOY
Jack L. Robbins and Alan D. Wheeler 8 Oct. 1965 26 p refs Presented at the 3d Intern. Conf. on Plutonium, London, 22-26 Nov. 1965 Submitted for Publication
(Contract W-7405-ENG-48)
(UCRL-14489; CONF-651102-11) CFSTI: HC $2.00/MF $0.50

The compressive creep characteristics of a plutonium–1 wt % gallium alloy were evaluated at a constant stress of 2000 psi over the temperature range 234° to 387°C. In all cases the true strain versus time curves manifested a predominantly tertiary type of behavior. This accelerating creep rate was not caused by internal cavity formation; rather, it was related to partial recrystallization and possibly an enhancement in the recovery processes. The apparent activation energy for creep was determined to be 33.7 ±2.5 kcal/mole independent of strain between values of 0 and 0.15. Author (NSA)

N66-25141# California Univ., Berkeley. Lawrence Radiation Lab.
THE STRENGTH AND TOUGHNESS OF DYNAMICALLY STRAIN AGED ALLOY STEELS
W. W. Gerberich (Aerojet-Gen. Corp., Sacramento, Calif.), V. F. Zackay, R. Busch, and E. R. Parker Oct. 1965 40 p refs Presented at the Intern. Conf. on Fracture, Sendai
(Contract W-7405-ENG-48)
(UCRL-16363; CONF-650949-2) CFSTI: HC $2.00/MF $0.50

The response of alloy steels to dynamic strain aging in both quenched and tempered and ausformed conditions were investigated. Strength, ductility, and toughness were measured as a function of straining and tempering temperatures. Structural observations were made on the strained and unstrained steels. By appropriate choice of strain and tempering temperatures, the strength of quenched and tempered steels was increased by about 40,000 psi, i.e., to the base strength of the ausform steels. The strength of the ausform steels was increased by about the same amount, suggesting that the strengthening effects are additive. In the ausform steels, yield strengths of 270,000 psi were achieved by dynamic strain aging with a reliability ratio (K_c/σ_{ys}) of one. Since the slope of K_c/σ_{ys} vs. σ_{ys} is small, it is suggested that this process may be used to attain yield strengths of 300,000 psi with exceptional toughness. Author (NSA)

N66-25210# California Univ., Livermore. Lawrence Radiation Lab.
THE EFFECT OF STRAIN RATE ON MECHANICAL PROPERTIES OF SOME WIDELY USED ENGINEERING METALS
K. G. Hoge 14 Dec. 1965 44 p refs
(Contract W-7405-ENG-48)
(UCRL-14599) CFSTI: HC $2.00/MF $0.50

A summary of the effects of strain rate on some of the mechanical properties of various types of structural materials is presented. Dynamic tensile data were obtained on a Dynapak machine at strain rates up to 200 in./in./sec and at temperatures from 75° to 900°F. Dynamic data from other sources are also presented. Some of this data are at strain rates as high as 9000 in./in./sec. Static data were obtained on a universal test machine at strain rates of 10^{-5} to 10^{-1} in./in./sec. Several theories on mathematical relationships between stress and strain rate were examined and evaluated in terms of experimental data. Author

N66-25216# Battelle-Northwest, Richland, Wash. Technical Information Section.
PLUTONIUM METALLURGY NOTEBOOK
M. E. Hasbrouck, ed. and M. P. Burns Sep. 1965 222 p refs
(Contract AT(45-1)-1830)
(BNWL-37) CFSTI: HC $6.00/MF $1.25

A compilation of data on the structure and properties of plutonium and its alloys is presented. Included are phase diagrams, crystal structure data, transformation kinetics, physical and mechanical properties, corrosion and corrosive properties, and radiation effects information. The information is current to September 1964. NSA

N66-25224# Battelle-Northwest, Richland, Wash. Reactor Metals Research Section.
HIGH TEMPERATURE CREEP-RUPTURE PROPERTIES OF HASTELLOY X IN VACUUM
D. H. Nyman Nov. 1965 28 p refs
(Contract AT(45-1)-1830)
(BNWL-167) CFSTI: HC $1.00/MF $0.50

The creep-rupture properties of Hastelloy X in vacuum were determined at 1950° F and 2100° F. Grain growth occurred at 2100°F for times greater than 20 hrs and caused a marked reduction in both ductility and time to rupture from values extrapolated from lower temperature data. Author (NSA)

N66-25231# Pratt and Whitney Aircraft, Middletown, Conn.
REFRACTORY METAL PROTECTIVE COATINGS FOR LONG TERM APPLICATIONS
L. A. Friedrich, N. S. Bornstein, and E. C. Hirakis Sep. 1965 66 p refs
(Contract AT(30-1)-2789)
(PWAC-499) CFSTI: HC $3.00/MF $0.75

A slurry applied coating was developed for the protection of refractory metal alloys in oxidizing, elevated temperature

environments. The coating system, designated PWK-5, is based on a niobium silicide barrier layer interposed between the base metal and a refractory aluminide, tin-containing envelope. The methods used in the application of the coating are readily adaptable to large structural configurations. Mean lifetimes, derived from a statistical analysis of oxidation data for the PWK-5 coated Nb–1 Zr alloy composite exposed in 650° and 1100°C air, exceeded 6000 and 800 hrs, respectively. The reaction kinetics of the composite with air at temperatures from 538° to 1204°C conformed to a parabolic rate process. Evaluation of the factors affecting the behavior of the composite in 1093°C air indicated that the penetration of tin through the silicide barrier layer was the principal factor limiting coating lifetime. Thus, the analytical data confirmed the wearout mode of failure indicated by statistical analysis. Limited testing at 1427°C indicated that coatings designed with thicker silicide or alloyed silicide barrier layers may be capable of providing increased lifetimes. Author (NSA)

N66-25236# California Univ., Livermore. Lawrence Radiation Lab.

MELTING, FABRICATION, AND CREEP TESTING OF A 1.39% Ti+0.34%Zr+ .30%C MOLYBDENUM ALLOY

H. F. Conrad and P. R. Landon 1 Nov. 1965 29 p refs
(Contract W-7405-ENG-48)
(UCRL-14437) CFSTI: HC $2.00/MF $0.50

The creep rupture strength values at 2400°F of TZC (0.3% C) were found to be about the same as those reported for commercial 0.15% carbon TZC alloy, rather than the much higher values previously reported for this high-carbon TZC composition. Creep properties at 2400° and 2600°F were disappointing. Because of the limited number of specimens available, it was not possible to investigate the improvement in properties no doubt possible through precipitation hardening heat treatments. In light of the recent work leading to a better understanding of the phase equilibria involved in this type of alloy, optimization of fabrication temperatures and procedures would additionally improve properties. Depletion of carbon at the specimen surface was found to occur during testing in conventional diffusion pumped vacuum systems. Decarburization apparently occurs as a result of a reaction between residual oxygen in the vacuum system and carbon in the specimen forming CO. Testing in an ultra-high vacuum, utilizing a sputter-ion pump, prevents decarburization. Author (NSA)

N66-25237# Battelle-Northwest, Richland, Wash.

EVALUATION OF IRON-BASE AND NICKEL-BASE ALLOYS FOR MEDIUM AND HIGH TEMPERATURE REACTOR APPLICATIONS, PART II

T. T. Claudson and H. J. Pessl Nov. 1965 67 p refs
(Contract AT(45-1)-1830)
(BNWL-154) CFSTI: HC $3.00/MF $0.75

When alloys were exposed up to 1060°C for 500 hr in flowing He and N_2 that had been first passed through graphite at 450° to 500°C, AISI 406 stainless steel, PDRL-102, Hastelloy X and N, and the Fe–30 Cr–1 Y type experimental alloy showed the lowest weight gains and increased in the order listed. When exposed for 100 hr to pure, dry CO_2 while in contact with powdered graphite at 100°F temperature intervals up to 1093°C, Hastelloy X gained the least in weight and was followed by Inconel X-750, Hastelloy R-235, and AISI 406 stainless steel. Extensive autoclave testing of the selected alloys in oxygenated and deoxygenated superheated steam at 550°C and 1000, 3000, and 5000 psi pressure; and at 650°C and 600 psi pressure, respectively, established the following tentative grouping of alloys with increasing resistance to corrosion: AISI 304, 316, 406, and 430 stainless steels showed weight gains from about 50 to 300 mg/dm^2, or over 0.2 mil of penetration; Fe–25 Cr–3 Al–0.6 Y, Hastelloy N, PDRL-102 and Inconel X-750 showed weight gains from about 8 to 75 mg/dm^2, or 0.1 to 0.2 mil penetration; and, Incoloy 800, AISI 446 stainless steel, Hastelloy X-280, Hastelloy R-235, and Fe–2 Cr–5 Al showed weight gains below 15 mg/dm^2, or less than 0.1 mil penetration. The oxygen content and pressure of the steam appear to affect the various alloys in different ways. Susceptibility to stress-corrosion cracking of the plastically and elastically prestressed alloys in 42% boiling, aqueous, magnesium chloride solution was severest for the type 300 stainless steels, and considerably less severe for the 400 series stainless steels, the Fe–Cr–Al-base alloys, and the nickel-base alloys Hastelloy X and PDRL-102. AISI 406 stainless steel and Incoloy 800 appear to be most resistant to stress condition. The effects of neutron exposure upon the mechanical properties of several iron- and nickel-base alloys were determined. Generally, the comparative ambient pre- and post-irradiation room temperature test results do not indicate any pronounced property changes because of irradiation, except for slight losses in strength and elongation. When tested at 700°C, radically different effects of irradiation were observed. In addition to a general deterioration of the tensile properties (which is to be expected at this testing temperature), most alloys suffer varying severe losses of yield and ultimate strength due to irradiation and a most pronounced decrease in elongation. These effects are least noticeable in the stainless steels where the 406 SS shows greatly increased elongation caused by irradiation. NSA

N66-25247*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EVALUATION OF SPECIAL 301-TYPE STAINLESS STEEL FOR IMPROVED LOW TEMPERATURE NOTCH TOUGHNESS OF CRYOFORMED PRESSURE VESSELS

Thomas W. Orange Washington, NASA, May 1966 20 p refs
(NASA-TN-D-3445) CFSTI: HC $1.00/MF $0.50 CSCL 11F

The purpose of the present investigation was to determine if notch toughness at cryogenic temperatures could be significantly improved by slight compositional modification. Coupons were cut from a cylindrical pressure vessel cryoformed from a special heat of 301-type stainless steel having low minor element content. Material from the same heat was also obtained which had been stretched in uniaxial (rather than 2 to 1 biaxial) tension. Smooth and sharp-notch tensile specimens made from the coupons were tested at ambient temperature, −320°, and −423° F. Results were compared with previous results for cryoformed AISI 301 and for AISI 301 cold reduced 60 percent. The effect of a stress relief treatment was also determined. At ambient temperature, the cryoformed special heat showed about the same yield and notch strengths as the previous cryoformed heat. At −320° and −423°F the special heat showed about the same yield strength but considerably higher notch strength than the previous heat. Weld efficiency was slightly above 100 percent at all three test temperatures. The stress relief treatment studied improved both strength and notch toughness at cryogenic temperatures. At 70° and −320°F the strength and notch toughness values for this special heat when cryoformed and stress relieved are superior to those of AISI 301 cold reduced 60 percent; at −423°F, however, the notch strength of the cryoformed material is somewhat lower. Author

N66-25289# General Dynamics Corp., Chicago, Ill. Liquid Carbonic Div.

DESCALING AND DECONTAMINATION STUDIES

T. F. D'Muhala 8 Jun. 1965 199 p refs
(SD-22)

A proprietary neutral descaling formulation designated RD16 was used in comparison with existing descaling agents for all tests conducted on presoiled laboratory test coupons. Formula modifications extended the utility and effectiveness of RD16 without grossly affecting desirable characteristics of neutrality, low metal loss and stability. Decontamination experiments were performed on metal coupons which had been precontaminated. RD16 surpassed the requirements for a radioactive soil decontaminant. Tests were conducted on actual reactor system components. Comparative tests were performed simultaneously with existing, approved, methods of decontamination. When used in a multi-step process, RD16 appears to be as effective a decontaminant as other processes tested. Further evaluation established the safety associated with RD16 for materials of construction and personnel. Formula modification resulted in a family of neutral decontaminating solutions, each for a specific purpose. Tests conducted in actual systems corroborated test data as to effectiveness, safety and economics. Author

N66-25336# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials.
A STUDY OF CsCl TYPE INTERMEDIATE PHASES INVOLVING RARE EARTH ELEMENTS
C. C. Chao Jun. 1965 55 p refs AEC Res. and Develop. Rept.-36
(Contract AT(04-3)-221)
(CALT-221-11) CFSTI: HC $3.00/MF $0.75

Results are presented of a systematic study of CsCl type phases in binary alloys of rare earth elements with other metals. Thirty-nine new phases of this type were found. The linear variation of the lattice parameter of CsCl phases with the trivalent ionic radius of the rare earth metal previously established for a limited number of alloys, was extended to seventy-nine phases. This linear relationship leads to some interesting qualitative arguments on the ionic size of the non-rare earth element in these phases. The electrical resistivities of nineteen CsCl type phases of rare earths with copper, silver, and gold were measured between 4.2°K and about 250°K. With the exception of the yttrium–silver phase, all others exhibited an anomaly in the resistivity-temperature curve which is attributed to an antiferromagnetic transition. This conclusion is confirmed by previously published results of neutron diffraction experiments and magnetic susceptibility measurements. The electrical resistivity results are interpreted on the basis of an indirect interaction between two rare-earth ions. These two ions can be both magnetic or non-magnetic, or mixed. Author (NSA)

N66-25346# Atomics International, Canoga Park, Calif.
METALLURGICAL STUDY OF NIOBIUM/TYPE 316 STAINLESS STEEL DUPLEX TUBING
P. B. Ferry and J. P. Page 5 Jan. 1966 37 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11191) CFSTI: HC $2.00/MF $0.50

Tests were made to determine the basic feasibility of using Nb/type 316 stainless steel duplex tubing in mercury Rankine boilers. The use of this material was determined to be feasible as indicated by quality, bond strength, bond life, and lack of hydrogen embrittlement. NSA

N66-25354# Atomics International, Canoga Park, Calif.
AN INVESTIGATION OF NICKEL-BASE BRAZING ALLOYS AND BRAZED JOINTS FOR SERVICE IN LIQUID SODIUM
Suk K. Lee 15 Dec. 1965 40 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11326) CFSTI: HC $2.00/MF $0.50

A series of nickel-base brazing alloys were tested in a liquid sodium thermal convection loop for a period of 10,000 hr at temperatures of 1200° and 700°F. The tests were conducted to establish the feasibility of a brazed calandria joint concept for the sodium graphite reactor application. The results indicated that Ni–Cr–Si–B (CM53) and Ni–Si–B (CM52) were the most resistant to sodium attack. The Ni–Cr–Si (CM60) would only be suitable for short term use (less than 1500 hr) or lower temperature (below 700°F) applications. A continued rise in remelt temperature, due to loss of brazing alloy melting temperature depressant constituents (Si and B) and to erosion of the joint parent material, will limit the number of cycles for rebraze and remelt of the calandria joints. The existing calandria joint design is susceptible to cracking and porosity formation, consequently joint integrity is questionable. It is believed however, that this may be overcome by joint design changes. Author (NSA)

N66-25357# Oak Ridge National Lab., Tenn.
RADIATION METALLURGY SECTION, SOLID STATE DIVISION PROGRESS REPORT FOR PERIOD ENDING AUGUST 1965
Jan. 1966 95 p refs
(Contract W-7405-ENG-26)
(ORNL-3878) CFSTI: HC $3.00/MF $0.75

The precipitation of nitrides in α-Fe was measured using low-frequency internal friction as a measure of the amount of N_2 in solid solution. The rate of precipitation was enhanced by neutron irradiation, but not by electron irradiation. However, if the electron dose was large enough, some evidence for the trapping of N_2 atoms by radiation-produced defects was seen. A Ni–40 wt % Cu alloy was given a series of isothermal anneals following irradiation at −180°C to a dose of 1×10^{17} neutrons/cm^2 E>1Mev). The activation energy for the radiation-enhanced segregation reaction was found to increase during the process, although from 23 to 192°C the energy was fairly constant at 1.2 to 1.3 ev. For a singly activated process, this energy is shown to correspond to the energy for motion of the diffusion-enhancing defect. Radiation hardening in Fe was investigated by stress relaxation techniques. The stress dependence of dislocation velocity for electron and neutron irradiated Fe was quite similar to that for unirradiated material. However, the threshold stress for macroscopic dislocation motion was increased significantly as a result of the irradiation. This factor, rather than the decrease in mobile dislocation density, was chiefly responsible for the radiation hardening in this material. No dose rate effect on the tensile properties was observed for Fe samples give a dose of 1.5×10^{19} neutrons/cm^2 (E>2.9 Mev) over a range of fluxes and from 4 to 70 ± 10^{11} neutrons cm^{-2} sec^{-1}. Experiments on the strain rate dependence of the yield stress showed that the yield stress asymptotically approaches the threshold stress as the strain rate is decreased. Measurements of lattice rotation in single crystals of Nb during tensile deformation indicated a considerable amount of latent hardening on the secondary slip system. Also, the departure of the orientation of the tensile axis from that predicted for single slip was correlated with the appearance of the slip bands on the surface and an increased rate of work hardening. Charecteristic changes in strength and ductility from neutron irradiation were observed. Efforts to reveal mobile dislocations in Nb by etch-pitting techniques were successful. Smooth and notched sheet tensile samples of types 330 and 270 nickel and type 410 stainless steel were irradiated to 10^{21} neutrons/cm^2 and the results of two types of annealing experiments are described. For

notched samples of type 330 nickel containing 0.03 wt % C, a large increase in strength was observed upon annealing to 427° C. A smaller increase in strength was also observed for smooth samples, but this is irradiation-anneal hardening was not exhibited by any of the other alloys. NSA

N66-25358# Bettis Atomic Power Lab., Pittsburgh, Pa.
THERMAL EXPANSION AND PREFERRED ORIENTATION IN ZIRCALOY
J. J. Kearns Nov. 1965 44 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-472) CFSTI: HC $2.00/MF $0.50

An X-ray method based on analysis of intensities in a diffractometer scan was developed to characterize preferred orientation in materials of hexagonal crystal structure. The method was applied to Zircaloy-4 swaged rod and to plate fabricated by four different processes. The data were used to determine an orientation parameter that can be used to calculate physical properties from single crystal values, or single crystal values from property measurements on polycrystalline samples. Measurements of thermal expansivity were used to verify the X-ray method, and single crystal values deduced from these data agreed well with published results. The X-ray data also were used to examine the applicability of the texture coefficient method to normalize intensity data from Zircaloy specimens. Author (NSA)

N66-25359# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
METALLOGRAPHY OF WROUGHT VACUUM-CAST BERYLLIUM AT ELEVATED TEMPERATURES
V. R. Friebel 22 Nov. 1965 15 p refs
(Contract AT(29-1)-1106)
(RFP-544) CFSTI: HC $1.00/MF $0.50

Microstructural changes in wrought vacuum-cast beryllium at elevated temperatures were studied with a vacuum hot-stage metallograph. The phenomena of grain growth and the removal of mechanical twins from the microstructure were recorded with a 16 mm movie camera. Author (NSA)

N66-25383# Battersea Coll. of Technology, London (England).
ACTIVATION SINTERING OF TUNGSTEN AND ITS EFFECT ON SOME MECHANICAL PROPERTIES Final Report, 1 Oct. 1962–31 Dec. 1965
I. J. Toth (Ph.D. Thesis) Nov. 1965 234 p refs
(Contract N62558-3591)
(AD-630440) CFSTI: HC $6.00/MF $1.25

The work is concerned with improvements in the sintering properties of Tungsten. Two methods of activation sintering are studied, halogen activation and metallic activation. An example of the first is the use of hydrogen and bromine as sintering atmosphere. No significant increase in densification was noted, except for a moderate improvement at temperatures around 1400°C. However, some beneficial effects were observed, notably in the rounded shape of the pores and in lowering the oxygen content. This led to an improvement in mechanical properties. Metallic activation, mainly provided by nickel and palladium salts led to high densities at a sintering temperature of 100°C but was accompanied by increased brittleness. This undesirable feature could be in part offset by controlling the amount of metallic activator and by some suitable subsequent heat-treatment. The two types of processes are discussed separately, some appropriate mechanisms are proposed to explain the results observed, and the theoretical implications are considered. Author (TAB)

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N66-23909# AVCO Corp., Wilmington, Mass. Research and Development Div.
DIFFUSION STUDIES IN REFRACTORY MATERIALS Summary Report, 1 Mar. 1965–28 Feb. 1966
Bernhardt J. Wuensch and Thomas Vasilos [1966] 16 p refs
(Contract Nonr-4267(00))
(AD-628610) CFSTI: HC $1.60/MF $0.50

Results of studies of diffusion in a ceramic oxide are described. The objectives of the program are to (1) determine the origin of enhanced grain-boundary diffusion, (2) determine the effect, if any, of imposed stress on diffusion rates in single-crystals, and (3) determine diffusion rates for impurity cations whose segregation and precipitation is known to influence transport and mechanical properties. Magnesium oxide has been selected for study as a typical ceramic oxide. Grain boundary diffusion has been observed in certain bicrystals and polycrystal-line specimens. The effect, however, is extrinsic in nature, and has been shown to arise from segregation, at grain boundaries, of the principal impurities contained within the MgO. No enhancement of Ni^{+2} diffusion rates is observed in MgO subjected to four-point loadings of up to 5000 psi at temperatures between 1000°C and 1300°C. Similarly, no enhancement is noted in MgO subjected to compressive loads up to 15,000 psi at 1200°C. Diffusion data obtained for Ca^{+2} in single-crystal MgO may be described by an activation energy of 3.3 electron volts, and a value of D_o equal to 0.25 sq cm/sec. Diffusion of Ca^{+2} is up to two orders of magnitude slower than for other divalent impurity cations, and the present results may be influenced by fluorescence effects in the microprobe analysis, or by incompletely resolved immiscibility-gap discontinuities in the concentration profiles. Author (TAB)

N66-24125# Case Inst. of Tech., Cleveland, Ohio. Dept. of Metallurgy.
AN INVESTIGATION OF THERMAL AND MECHANICAL STABILITY OF MOLD MATERIALS FOR STEEL CASTINGS Interim Report, 27 Jun. 1964–30 Jun. 1965
[1965] 45 p
(Contract DA-33-019-AMC-270(Z))
(AMRA-CR-64-03/2; AD-628387) CFSTI: HC $4.60/MF $0.50

A test apparatus was developed to measure the tensile strength of molding materials at elevated temperatures. The measurements of tensile strength obtained from this equipment permits a qualitative evaluation of the ability of a mold to maintain casting dimensions. Several rammed mold materials consisting of various combinations of refractory aggregates and binders were investigated for use in producing high quality steel castings. The aggregates selected for study included mullite, zircon, silica sand, fused silica, olivine, and calcined

alumina. These were bonded with western bentonite and sodium silicate. Close dimensional control was obtained with all aggregates bonded with sodium silicate and with the zircon and mullite aggregates bonded with western bentonite. The casting surfaces obtained with the fused silica and zircon were generally superior to those produced in other aggregates.
Author (TAB)

N66-24733# Harry Diamond Labs., Washington, D. C.
LOW-LOSS STYRENE-TYPE FOAM-IN-PLACE ENCAPSULATING RESINS
F. J. O. Engelhardt 15 Oct. 1965 24 p refs
(HDL-TR-1308; AD-628537) CFSTI: HC $2.60/MF $0.50

Low-dielectric-loss styrene-type foam-in-place encapsulating resins are not available commercially. Such a resin has now been developed. A propellant was added to the catalyzed styrene-polystyrene mixture; as the temperature of the polymerizing resin rose, the propellant expanded the resin into a cellular structure. Homogeneous foams were obtained in the presence of finely powdered polymers, which acted as bubble nucleators. The resultant rigid foams had dielectric constants ranging from 1.2 to 1.8, and loss tangents from 0.0002 to 0.001 over the frequency range 10^2 and 10^8 cps. Some of these materials had remarkably flat loss-frequency curves, losses ranging only between 0.0004 and 0.0005 over the same frequency range. Densities were varied between 0.194 and 0.850 g/cm^3, or between 12 and 53 lb/ft^3. These data indicate the usefulness of the new cellular materials as rf encapsulating resins.
Author (TAB)

N66-24747# National Academy of Sciences—National Research Council, Washington, D. C. Materials Advisory Board.
REPORT OF THE AD HOC COMMITTEE ON INTERFACE PROBLEMS IN FIBROUS COMPOSITES Final Report
Nov. 1965 56 p refs
(Contract ARPA SD-118)
(MAB-214-M)

This report on fibrous composites deals with the fiber surface, the process of composite formation, retention of properties in service, and the interface during composite failure. The approach used was, first, to develop an awareness of the general state of knowledge of interface characteristics in fibrous composites and, second, to assess the relevance of interface characteristics to composite performance. Study of the factors that influence the structure of interfaces was a necessary part of this analysis. The overall objective was to display selected, potentially critical facets of the situation to identify areas in which additional research is needed and to make recommendations for strengthening the research effort in this field. The study did not attempt either a comprehensive review or the solution of particular current problems.
Author

N66-24916*# National Aeronautics and Space Administration, Washington, D.C.
NATURE OF THE MgO AND Al_2O_3 CONDUCTIVITY [KHARAKTER PROVODIMOSTI MgO I Al_2O_3]
V. P. Luzgin, A. G. Frolov, A. F. Vishkarev, V. I. Yavoyskiy, L. V. Vinogradova et al Apr. 1966 12 p refs Transl. into ENGLISH from Ogneupory (Moscow), v. 30, no. 4, 1965 p 42–44
(NASA-TT-F-10093) CFSTI: HC $1.00/MF $0.50 CSCL 11B

Baked magnesium oxide and corundum were used in order to study the electrical conductivity of solid oxides at temperatures ranging from 1500° to 1700° C. The oxides were employed as solid electrolytes in a galvanic concentration cell. It was determined that the magnesium oxide is primarily an ion conductor, and that the aluminum oxide is a combined conductor with electron conduction on the order of 25%.
D.T.

N66-24972*# Stanford Research Inst., Menlo Park, Calif.
POLYMERS FOR SPACECRAFT HARDWARE MATERIALS SPECIFICATIONS AND ENGINEERING INFORMATION Monthly Technical Progress Report No. 21, Feb. 10–Mar. 9, 1966
R. F. Muraca, N. Fishman, H. G. Thomas, and J. S. Whittick 15 Mar. 1966 21 p ref Prepared for JPL
(Contracts NAS7-100; JPL-950745)
(NASA-CR-74688) CFSTI: HC $1.00/MF $0.50 CSCL 11J

Additional progress is reported in the development and preparation of specifications for polymeric materials that are to be used in the fabrication of spacecraft hardware. The status of the development of chemical test methods for RTV-silicone potting compound base materials, epoxy-silver solder paste, and polyurethanes is discussed and the results which have already been obtained are presented in tabular form. The densities of selected silicone base materials are reported and thermal vacuum weight loss determinations for two polyvinylfluoride films, a polyphenyl ether, and two representative polyfluorocarbon materials are examined. It is reported that the microvolatile condensable material (VCM) apparatus is operational and the results of micro-VCM determinations for some control samples are discussed.
H.S.W.

N66-24980*# Stanford Research Inst., Menlo Park, Calif.
POLYMERS FOR SPACECRAFT HARDWARE: MATERIALS SPECIFICATIONS AND ENGINEERING INFORMATION Interim Report No. 2, Aug. 1965–Mar. 1966
15 Mar. 1966 105 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950745)
(NASA-CR-74657) CFSTI: HC $4.00/MF $0.75 CSCL 11J

Test methods are discussed for the chemical and physical properties of epoxy adhesives and RTV-silicone rubbers (including curing agents). Results for typical polymeric materials and the details for suggested specification test-methods are also given. A standardized procedure for thermal-vacuum weight-loss of polymeric materials is described; results are given for 20 polymeric materials, and weight-loss limits for materials are suggested. Units for the determination of volatile condensable material (VCM) are described; these units will provide engineering information on VCM but they have not been put into service at this time. A micro-VCM unit, designed to screen polymeric materials, is in operation; available data on VCM, as well as weight-loss are given. The results of mass spectrometric studies of substances volatilized from typical space polymers are presented.
Author

N66-24981*# National Bureau of Standards, Washington, D.C.
POLYMER DECOMPOSITION INITIATED BY HIGH ENERGY RADIATION Progress Report, Nov. 1965–May 1966
Leo A. Wall Apr. 1966 10 p refs
(NASA Order R-56)
(NASA-CR-74662) CFSTI: HC $1.00/MF $0.50 CSCL 11I

Progress is reported in the study of polymer decomposition initiated by high energy radiation. A study of the gamma ray initiated thermal depolymerization of polytetrafluoroethylene showed that the mechanism consists of random initiation, termination by combination, and the kinetic chain lengths are short. In considering the thermal decomposition of anionically prepared polymers of 1,2-dihydronaphthalene, it was found

that the polymer was only slightly better than polystyrene, and unlike polystrene, appeared to decompose exothermically. H.S.W.

N66-24982*# Stanford Research Inst., Menlo Park, Calif.
POLYMERS FOR SPACECRAFT HARDWARE MATERIALS SPECIFICATIONS AND ENGINEERING INFORMATION Monthly Technical Progress Report No. 19, Dec. 10, 1965–Jan. 9, 1966
R. F. Muraca, N. Fishman, H. G. Thomas, and J. W. Whittick 15 Jan. 1966 24 p Prepared for JPL
(Contracts NAS7-100; JPL-950745)
(NASA-CR-74664) CFSTI: HC $1.00/MF $0.50 CSCL 11J

The results of thermal vacuum weight loss determinations are summarized for certain silicone elastomers, silicone foamed rubber, acrylic-glass fiber sleeving, epoxy varnish, and solder paste. The nonvolatile contents of various RTV type silicone base materials were determined and the results of these determinations are given. The assemblies constructed for observing polymeric materials under constant strain during an eight month exposure to a thermal vacuum environment are described, and the preliminary data for conducting these tests are provided. H.S.W.

N66-24984*# Stanford Research Inst., Menlo Park, Calif.
POLYMERS FOR SPACECRAFT HARDWARE MATERIALS SPECIFICATIONS AND ENGINEERING INFORMATION Monthly Technical Progress Report No. 18, Nov. 10–Dec. 9, 1965
R. F. Muraca, N. Fishman, H. G. Thomas, and J. S. Whittick 15 Dec. 1965 15 p ref Prepared for JPL
(Contracts NAS7-100; JPL-950745)
(NASA-CR-74666) CFSTI: HC $1.00/MF $0.50 CSCL 11I

Two chemical test procedures are described for determining filler content and hydrolyzable halide content in RTV type silicone potting compound base materials. The results of these analyses for representative materials are summarized. It was determined that the extraction procedure using chlorobenzene or methylethyl ketone was not suitable for Epon 422J glass fiber tape and continued investigations indicated that a Soxhlet extraction procedure is required, and that acetone is a suitable solvent. Additionally vacuum weight loss data for Eccocoat EC/200, Eccocoat VE, clear varnish B-276 and Eccobond solder 56C/9 are summarized. H.S.W.

N66-24985*# Stanford Research Inst., Menlo Park, Calif.
POLYMERS FOR SPACECRAFT HARDWARE: MATERIALS SPECIFICATIONS AND ENGINEERING INFORMATION Monthly Technical Progress Report No. 17, Oct. 10–Nov. 9, 1965
R. F. Muraca, N. Fishman, H. G. Thomas, and J. S. Whittick 15 Nov. 1965 16 p ref Prepared for JPL
(Contracts NAS7-100; JPL-950745)
(NASA-CR-74665) CFSTI: HC $1.00/MF $0.50 CSCL 11I

Reported are the results of vacuum weight loss determinations for two polyurethane coatings for use in spacecraft hardware fabrication. These coatings are designated as JPL conformal coatings 1001 and 1002. The preparation of the materials for weight loss determinations is discussed and the results of these determinations are presented in tabular form. The values obtained indicate that these materials may be classed with the better grade of space polymer. It is reported that the values for JPL 1002 appear slightly better than JPL 1001 after 192 hours of exposure in the thermal vacuum environment; however, the latter achieved an apparent leveling off within 96 hours, and the former did not show such an indication after 192 hours. Weight loss determinations were also made for Mircarta H-8457 and Mircarta 65M25. The results of these determinations are also discussed. The work performed on the fabrication of clam shell units, which will provide engineering information on volatile condensable materials, is discussed. In addition, the effects of a vacuum thermal environment on the mechanical properties of silicone rubbers SE-555 and 3604, and Hycars-1 and 3 are examined. H.S.W.

N66-25074# Georgia Univ., Athens. Dept. of Physics.
INFRARED SPECTRA OF PLASTICS AND ELASTOMERS AFTER NUCLEAR IRRADIATION Progress Report
W. C. Sears 8 Sep. 1965 21 p refs
(Contract AT(40-1)-2418)
(TID-22479) CFSTI: HC $1.00/MF $0.50

Studies were made on changes in molecular structure produced by high-energy radiation on different organic polymers and to determine the mechanisms of radioinduced growth and decay of unsaturation and changes in polymer crystallinity, crosslinking, and cission. The structural changes were determined by measuring the spectra of polymer films before and after irradiation. The polymers exposed to gamma irradiation were: Neoprene, polyethylene, polybutadiene, polyurethan, and olefins. NSA

N66-25109# Stanford Univ., Calif. Stanford Linear Accelerator Center.
PHYSICAL PROPERTIES OF FILAMENT WOUND GLASS EPOXY STRUCTURES AS APPLIED TO POSSIBLE USE IN LIQUID HYDROGEN BUBBLE CHAMBERS
H. Brechna and W. Haldemann Jul. 1965 47 p refs Presented at the 1965 Cryog. Eng. Conf., Houston, Tex., 23–25 Aug. 1965
(Contract AT(04-3)-400)
(SLAC-PUB-121; CONF-650802-14) CFSTI: HC $2.00/MF $0.50

Physical property tests on glass filament-epoxy-film-composites which were recently proposed as a feasible material for a liquid hydrogen bubble chamber body placed in a very high pulsed magnetic field are described. Static and dynamic loadings, dielectric strength, thermal conductivity, and permeability to liquids at various temperatures such as 300, 77.8, 28 and 4.2°K tests are performed on straight rectangular pieces of different composition at various thicknesses up to one inch and a series of cylinders up to 0.0362 inch wall thickness, up to failure stresses. It is found that the physical properties of some of these composites are entirely suitable for liquid hydrogen bubble chamber use, namely at temperatures of 28°K and an internal pressure of 150 psi. Fatigue tests up to 10^7 cycles of operation up to 9000 psi flexural and 300 psi shear stress showed that the filament structure had not lost its original properties. Author (NSA)

N66-25284# Joint Publications Research Service, Washington, D.C.
ANTICORROSIVE PLASTIC COATINGS
V. G. Samsonov, V. G. Kharakhash et al 11 May 1966 71 p refs Transl. into ENGLISH of the book "Protivokorrozionnyye Plastmassovyye Pokrytiya" Kiev, "Tekhnika" Publishing House, 1965 p 4–91
(JPRS-35452; TT-66-31888) CFSTI: $3.00

The use of corrosion resistant polymeric materials for protective coatings on the inner surfaces of ferrous and stainless steel containers, pipes, and valves is discussed. Technological

methods and pertinent data are presented for the economic and efficient use of these materials; and the results of a mechanical, chemical, and physical properties investigation are given. D.T.

N66-25356# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
EVALUATION OF BINDERS FOR MACHINABLE UNFIRED CERAMICS
A. R. Teter 10 Dec. 1965 16 p refs
(Contract AT(29-1)-1106)
(RFP-659) CFSTI: HC $1.00/MF $0.50

Twenty-seven different combinations of binders were mixed with alumina powder to study tensile strength in unfired oxide parts and its relationship to machinability. Isostatically pressed oxides were impregnated with waxes to further increase their mechanical strengths for machining. Alumina, magnesia, zirconia, and zircon bars containing 4.0% polyvinyl alcohol were tested to compare the strength of equal amounts of binder in different oxides. In these bars the variation in tensile strengths was found to be due mainly to difference in particle size. Machinability was found to improve as the binder tensile strength increased. Author (NSA)

N66-25378*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
EFFECT OF PREDEFORMATION ON THE MECHANICAL PROPERTIES OF SODIUM CHLORIDE CRYSTALS
P. J. Shlichta 1 May 1966 42 p refs
(Contract NAS7-100)
(NASA-CR-74952; JPL-TR-32-923) CFSTI: HC $2.00/MF $0.50 CSCL 20B

Sodium chloride crystals were grown from melt as uniform <100>rods, 3 to 5 mm in diam. with flat {100} faces. The mechanical properties of these as-grown crystals were compared with those of predeformed crystals and with annealed, water-polished cleavages of comparable size, purity, and dislocation density. Bend tests were performed. The stress-strain curves of the as-grown crystals were similar to those of face-centered cubic metals; they showed a sharp yield point, a region of easy glide of slope, and a second stage of increased work-hardening rate beginning at 5.5 to 8% strain. In contrast, the stress-strain curves of the predeformed crystals and cleavages showed numerous idiosyncrasies, such as anelastic feet and soft vs stiff behavior. Although the as-grown crystals were exposed to divers atmospheric environments prior to testing, there was no indication of embrittlement. When bent under water the as-grown crystals showed a dramatic increase in ductility and could be tied in knots. N.E.N.

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N66-23925# Information Research Associates, Inc., Cambridge, Mass.
THE CONSISTENCY OF A NON-PARAMETRIC DECISION PROCEDURE Technical Note No. 3
Joel Owen 1 Sep. 1965 18 p refs
(Contract Nonr-4752(00))
(Rept.-100-6; AD-628710) CFSTI: HC $1.00/MF $0.50

It has been suggested that if a discriminating procedure is to adapt to an environment, it must not be limited by erroneous assumptions concerning the unknown distributions or functional form for the discriminator. This technical note displays mathematically the analogy between the notion of learning and the concept of consistency originally defined for parameter estimation. Moreover, some information concerning limiting behavior is deduced. Author (TAB)

N66-23964# California Univ., Berkeley. Dept. of Mathematics.
SOME CONSIDERATIONS ON EVOLUTIONARY ALGORITHMS
Joseph A. Goguen Feb. 1966 19 p refs
(Contracts Nonr-3656(08); Nonr-222(85))
(AD-629107) CFSTI: HC $1.60/MF $0.50

This paper contains some results and speculations inspired by and related to H. J. Bremermann's work on evolutionary search. Bremermann's work studies the behavior of evolutionary alogarithms on two well understood problems. Linear programs and (in some earlier experiments) systems of linear equations. It is then possible to judge the effectiveness of various evolutionary methods for these problems by comparing with known results and alogarithms. Evolutionary algorithms are search procedures, and therefore fall into the general area of artificial intelligence. Some of the results here may have relevance to this broader topic. The use of evolutionary analogy and terminology may suggest some significance for biology. This is all discussed. A theorem is presented which demonstrates the value of 'mutation'.
Author (TAB)

N66-23965# Harvard Univ., Cambridge, Mass. Dept. of Statistics.
STOCHASTIC POINT PROCESSES: LIMIT THEOREMS
Jay R. Goldman 4 Feb. 1966 54 p refs Submitted for Publication
(Contract Nonr-1866(37))
(TR-3; AD-629525) CFSTI: HC $5.60/MF $0.50

A stochastic point process in R(N) is a triple (M, B, P) where M is the class of all countable sets in R(N) having no limit points, B is the smallest sigma-algebra on M which makes the functions $N_S(X)$, defined by $N_S(X)$ = the number of points of X in S where X belongs to M and S is a Borel set in R(N), measurable, and P is a probability measure on B. A variety of operations on point processes which yield new point processes can be defined; e.g., superposition, deleting points, random translations of points, and clustering of points. The sequence of processes produced by iteration of these operations on a specified point process will, under very general conditions and for a wide class of point process including the stationary ones, converge to a mixture of Poisson processes. These results are established via a generalization of a classical limit theorem for Bernoulli trials. Author (TAB)

N66-23958# Institute for Defense Analyses, Arlington, Va. Jason Div.
SINGULAR SOLUTIONS OF CERTAIN INTEGRAL EQUATIONS

Kenneth M. Case (Mich. Univ.) Feb. 1966 46 p refs (Contract ARPA SD-50)
(IDA/HQ-66-4533; P-240; AD-629685) CFSTI: HC $4.60/MF $0.50

A class of integral equations arising in some idealized plasma problems is discussed. While these do not have solutions in the space of square integrable functions, they do have such in an appropriate space of generalized functions. Explicit solutions are given in some special cases. It is then shown how these solutions can be used to approximate those for more general problems. Author (TAB)

N66-23965# California Univ., Berkeley. Coll. of Engineering.
ON THE GEOMETRY OF OPTIMAL PROCESSES, PART III
A. Blaquiere and G. Leitmann (Paris Univ.) Jan. 1966 62 p (Contract Nonr-3656(31))
(AM-66-1; AD-629000) CFSTI: HC $6.60/MF $0.75

The geometric properties of optimal processes are considered for a system described by a finite number of control variables which govern the evolution of its states. This report continues the investigation of nonautonomous systems, variable end point problems, state-dependent control constraints, and certain geometrical properties. Applications are given for a one-dimensional regulator problem, a power-limited rocket problem, and a navigation problem. E.A.O.

N66-24287# Joint Publications Research Service, Washington, D.C.
ON FUNCTIONAL COMPLETENESS IN CALCULABLE LOGIC
G. P. Gavrilov *In its* Probl. in Cybernetics 7 Mar. 1966 p 1–103 refs (See N66-24286 13-08) CFSTI: $7.08

In a study of functional completeness in calculable logic an attempt was made to establish a practical criterion for determing the completeness of any given set P_{N_0}. It is first proved that the power of all precomplete classes in P_{N_0} is equal to a hypercontinuum. Next, a solution is given to the problem of completeness of sets containing a subset of all functions which depend on no more than one variable. Finally, a discussion is presented on the results of the investigation of completeness of the sets containing the subset of all different functions of one variable not producing a single value. D.T.

N66-24296# Joint Publications Research Service, Washington, D.C.
ALGEBRAIZATION OF A SET THEORY MODEL OF LANGUAGE
M. Novotnyy *In its* Probl. in Cybernetics 7 Mar. 1966 p 341–355 refs (See N66-24286 13-08) CFSTI: $7.08

An R-system, i.e., a set in which a class of relationships is defined, was investigated. Some concepts from the theory of equivalence relationships and the theory of subdivision of sets, necessary to the development of an R-system, were studied, along with the homomorphisms of the system. It is shown that any subdivision of the R-system may be algebraized so that it in itself is an R-system. Also investigated were the structure of congruence relationships in the system. Finally, the results of the investigation were applied to the study of an R-system set theory model of language. D.T.

N66-24297# Joint Publications Research Service, Washington, D.C.
COMPLEXITY OF RECOGNITION OF SYMMETRY IN TURING MACHINES
Ya. M. Barzdin' *In its* Probl. in Cybernetics 7 Mar. 1966 p 358–362 (See N66-24286 13-08) CFSTI: $7.08

The following theorem is used for an investigation of Turing machines which operate on two track tape. For any normal alogrithm Z which realizes the inversion of words, a constant C_Z exists such that for almost all words x in the alphabet A

$$t_Z(x) \geq \frac{C_x |x|^2}{(\log_2 |x|)^2}$$

where $|x|$ is the length of the word x and $t_Z(x)$ is the number of steps required for the inversion. It is then shown that the Turing machine recognizes a symmetry predicate S if it calculates for any word x

$$S(x) = \begin{cases} 1, \text{ if } x \text{ is symmetrical} \\ 0, \text{ if } x \text{ is not symmetrical.} \end{cases}$$

D.T.

N66-24298# Joint Publications Research Service, Washington, D.C.
CONSTRUCTION OF A UNIVERSAL ERROR CORRECTION FUNCTION OF TWO INPUT VARIABLES
V. A. Buyevich *In its* Probl. in Cybernetics 7 Mar. 1966 p 363–367 refs (See N66-24286 13-08) CFSTI: $7.08

Problems relating to error correction (EC) functions and operators were investigated. For simplicity, it was posited that the input and output variables of the EC functions assume only two values, 0 and 1. For the class of all EC functions the operations of superposition and feedback were introduced. It is pointed out that the set of EC functions is called complete if from its elements, using the above operations, it is possible to obtain any EC function. It is noted that in an earlier work, the problem of completeness for the set was reduced to the investigation of EC functions with one output variable. The investigation is primarily devoted to these functions. Finally, the following theorem is proven: The universal EC function of two input variables with one output variable exists. D.T.

N66-24300# Joint Publications Research Service, Washington, D.C.
ON THE PRODUCT OF MATRIX GAMES
Ye. P. Lipatov *In its* Probl. in Cybernetics 7 Mar. 1966 p 375–379 refs (See N66-24286 13-08) CFSTI: $7.08

Given: that $A = (a_{ij})$ be the payoff matrix of the game Γ_A, that $B = (b_{kl})$ be the payoff matrix of the game Γ_B, and that the matrix C be the Kronecker product of the matrices A and B; the following is proven. In the game $\Gamma_C = \Gamma_{A \times B}$ $v_C = v_A \cdot v_B$, and the set of Kronecker products of the optimal strategies of the games Γ_A and Γ_B is the subset of the set of optimal strategies of the game Γ_C. D.T.

N66-24301# Joint Publications Research Service, Washington, D.C.
ON A COMBINATORY PROBLEM
Al. A. Markov *In its* Probl. in Cybernetics 7 Mar. 1966 p 380–384 ref (See N66-24286 13-08) CFSTI: $7.08

Problems which arise in the construction of noise proof control codes consisting of n three-pulse commands are investigated. It is required to construct a three-row rectangular table $||a_{ij}||$, $i = 0, 1,$ and 2, and $j = 0, 1, \ldots, n-1$, which satisfies the following conditions: (1) each number from 1 to 3n must be in it once and only once; and (2) for each

$j = 0, 1, \ldots, n - 1$, $a_{oj} + a_{1j}\, a_{2j}$. An example of such a table is given for n = 9. If the table satisfies these conditions, then the number $3n(3n + 1)/4$ must be an integer; for this it is necessary that n have the form 4l or 4l + 1. It is shown that the latter value is also sufficient for the existence of the table, $||a_{ij}||$ 3 × n in size, which is subject to the above conditions. The proof consists of the construction of the corresponding table for each of the cases, n = 4l and n = 4l + 1. D.T.

N66-24302# Joint Publications Research Service, Washington, D.C.

ASYMPTOTIC EVALUATION OF THE COMPLEXITY OF A CLASS OF SELECTION ALGORITHMS

R. G. Nigmatullin *In its* Probl. in Cybernetics 7 Mar. 1966 p 385–395 ref (See N66-24286 13-08) CFSTI: $7.08

The following problem is posed: For any set $s = (s_1, \ldots, s_n) \subseteq T_{nm}$, and $i(1 = i = m)$ is found such that $t_i = s$. An attempt was made to establish a class of nontrivial selection algorithms for the solution of this problem. For certain assumptions the evaluations for the variable S(n, m) were obtained in the class of regular algorithms where the lower estimate occurred only for the short matrices with a small m. Also, more complicated matrices were constructed, and asymptotic evaluations of S(n, m) are offered for larger values of m. D.T.

N66-24303# Joint Publications Research Service, Washington, D.C.

ON COMPARISON OF THE COMPLEXITY OF REALIZATION OF MONOTONIC FUNCTIONS BY FORMULAE TO THE BASES (V, &) AND (V, &,–)

V. Ya. Pivkin *In its* Probl. in Cybernetics 7 Mar. 1966 p 396–403 (See N66-24286 13-08) CFSTI: $7.08

The realization complexity of monotonic functions in a class of Π-systems made up of closure contacts is compared with the realization of their arbitrary Π-systems. The following functions are introduced: (1) $L_\Pi(f)$ is the number of contacts in the minimal system realizing f in the class of arbitrary Π-sytems; and (2) $L_{+\Pi}(f)$ is the number of contacts in the minimal system realizing f in the class of Π-systems of closure contact. It is pointed out that isomorphism exists between the class of Π-systems of closure contacts and the formulae of the algebra of logic to the base (V,&) and also the formulae of the algebra of logic to the base (V,&,–), where negations in these formulae are encountered only on the variables. D.T.

N66-24395*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

CONCERNING THE PROPER ROTATIONS OF A 3-DIMENSIONAL ORTHOGONAL FRAME

Albert G. Gluckman Jan. 1966 15 p

(NASA-TM-X-55449; X-547-66-16) CFSTI: HC $1.00/MF $0.50 CSCL 12A

This mathematical discussion concerning the proper rotations of a 3-dimensional orthogonal frame is a study of the 6 different elements of the group of proper rotations: the proper orthogonal group O^+ (3) (or as it is otherwise called, the special orthogonal group SO (3)), which are formed as products of the 3 elements M_x, M_y, and M_z, expressing rotation about each of the 3 coordinate axes. These 3 products are formed by permutating the order of the multiplication of the 3 proper rotation matrices, M_x, M_y, and M_z, where they describe rotation of the frame about the x-, y-, and z-coordinate axis. The angles of rotation are chosen in such a manner, that no one of the unimodular factors M_x, M_y, and/or M_z is an identity element: thus $\theta_i \neq \pm 2\, k\, \pi$; i = 1, 2, or 3; k = 0 or a positive integer. For in that eventuality, the system which is described would be reduced to one involving 2 proper rotation matrices only. Such a case would then be a constraint placed upon the system as originally conceived, which would affect the generality of the conclusions. The angles θ_1, θ_2, and θ_3 of rotation about the x-, y-, and z-coordinate axis respectively, are elements of the field R^1 of real numbers. The frame itself is embedded in a 3-dimensional continuum, which though it could be globally Euclidean, is at the least locally Euclidean. Author

N66-24457# Information Research Associates, Inc., Cambridge, Mass.

NON-PARAMETRIC PATTERN RECOGNITION. PART I: THE LOCALLY DISJOINT CASE Technical Report No. 1

Joel Owen 1 Jul. 1965 23 p refs

(Contract Nonr-4752(00))

(IRA-100-1; AD-628706) CFSTI: HC $1.00/MF $0.50

The validity of the decision theoretic approach to pattern recognition depends primarily on the assumptions of the unknown underlying probability distribution. Here a mathematically rigorous procedure is developed which transforms the underlying unknown probability structure and then partitions the space by nonparametric techniques. In particular, the procedure transforms the learned samples to the real line using a functional which is dependent on estimates obtained from the learned samples. Treating these transformed one-dimensional random variables in terms of cumulative distribution, the underlying probability space is then partitioned by the fact that the location of the extrema of the difference or cumulative functions will converge to the boundaries of the likelihood decision rule. The decision rule which essentially defines this procedure is dependent on the location of the extrema. Moreover, this decision will provide perfect discrimination between category j and k for some finite learning phase if j and k are locally separate or disjoint. Author (TAB)

N66-24458# Information Research Associates, Inc., Cambridge, Mass.

NON-PARAMETRIC PATTERN RECOGNITION. PART II: THE NON-DISJOINT CASE Technical Report No. 2

Joel Owen 1 Oct. 1965 13 p refs

(Contract Nonr-4752(00))

(IRA-100-5; AD-628707) CFSTI: HC $1.00/MF $0.50

In Part I of this paper (AD-628 706), a non-parametric discrimination technique was proposed. It was shown that when perfect discrimination was possible, this technique achieved this perfection and in certain cases achieved it with a finite learning phase. In this report, properties of this technique are investigated for the case when perfect discrimination is not possible. In particular, it is shown that even under these conditions asymptotic optimality in the risk sense is attained. Author (TAB)

N66-24550*# Brown Univ., Providence, R.I. Center for Dynamical Systems.

PERIODIC SOLUTIONS OF DIFFERENTIAL EQUATIONS WITH TIME LAG CONTAINING A SMALL PARAMETER

Carlos Perello [1965] 54 p refs

(Contract NAS8-11264; Grant AF-AFOSR-833-65)

(NASA-CR-74814) CFSTI: HC $3.00/MF $0.50 CSCL 12A

In this paper it is shown that the method of Cesari and Hale for the determination of periodic solutions of ordinary

differential equations can be extended to the case in which these equations contain a time lag. These equations with time lag differ from those without lag in that the derivative of a solution function at a time t depends also on the values of this solution at times preceding t. Furthur restrictions are made of the equations by considering only time lags less than a fixed number r. Required background material is given, and a method is developed for (γ) nonautonomous. The reduction of (γ) autonomous to a previous case is treated, and it is shown how the basic procedure can be used to determine the asymptotic stability of periodic solution. A simple example arising from a control system with a delay in the feedback is presented, and the procedure to be followed when higher order terms have to be used to ascertain the existence of periodic solutions is discussed. C.T.C.

N66-24653# General Electric Co., Philadelphia, Pa. Missile and Space Div.
THREE-DIMENSIONAL GAUSSIAN PROBABILITIES FOR ELLIPSOIDAL VARIANCES
C. R. Seliger 13 Sep. 1965 45 p refs
(Rept.-655D323)

A technique was developed for generating two and three dimensional Gaussian probabilities for elliptical and ellipsoidal variances. The method consists of converting the ellipse into an equivalent circle and the ellipsoid into an equivalent sphere. The equivalences are achieved by allowing each circle to have the same circular error probability as its parent ellipse and each sphere to have the same spherical error probability as its parent ellipsoid. It is pointed out that the technique holds for the interdependence of variables, as well as the independence. D.T.

N66-24707# Naval Postgraduate School, Monterey, Calif.
MATHEMATICS: A SELECTED LIST OF MATERIALS IN THE LIBRARY OF THE U. S. NAVAL POSTGRADUATE SCHOOL COMPILED AS A GUIDE TO FACILITATE THE USE OF THE COLLECTION
E. R. Larson Jan. 1966 13 p refs
(TR-58; AD-627708) CFSTI: HC $1.00/MF $0.50

The bibliography is intended as a guide to the collection of the U.S. Naval Postgraduate School Library in the field of mathematics. It is not a comprehensive listing of such material but is highly selective and reflects the holdings of the library. In many cases the publications listed are representative of other materials also in the School Library. Author (TAB)

N66-24734# Polytechnic Inst. of Brooklyn, Farmingdale, N.Y. Dept. of Electrical Engineering.
APPLICATION OF GAME THEORY TO THE SENSITIVITY DESIGN OF SYSTEMS WITH OPTIMAL CONTROLLER STRUCTURES
P. Dorato and A. Kastenbaum [1965] 11 p refs
(Contracts DA-31-124-ARO-D-316; AF 49(638)-1402)
(AFOSR-65-2102; AD-628296) CFSTI: HC $1.60/MF $0.50

The theory of games is applied to design of systems with unknown plant parameters. It is assumed that a controller structure is known and furthermore this controller is optimal when the controller parameters are equal to the plant parameters. The performance index then becomes a function of plant and controller parameters. This function is treated as a pay-off function with the antagonists represented by the controller and plant parameters. Author (TAB)

N66-24760# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
THE VOIGT FUNCTION: AN EIGHT-SIGNIFICANT-FIGURE TABLE AND GENERATING PROCEDURE
David G. Hummer 23 Nov. 1964 48 p refs
(JILA-24)

A procedure is developed for generating the normalized Voigt function U(a,x) capable of yielding eight or more significant figures. A table of this function has been prepared giving U(a,x) to eight significant figures for x = 0(.05)5(.1)10 and for twenty-five values of a in the interval $0 < a < .5$. A listing of the generating subroutine is included. Author

N66-24862# White Sands Missile Range, N. Mex. Instrumentation Development Directorate.
A METHOD FOR USING TRACKING DATA TO DETERMINE COORDINATE TRANSFORMATIONS
William L. Shepherd Sep. 1965 22 p refs
(STEWS-ID-65-5; AD-471786)

Least squares methods are used to obtain a rectangular transformation of coordinates from missile position data from two tracking instruments. The transformation is from a rectangular coordinate system to which the first instrument refers measurements to another such system to which the second instrument refers measurements. No information concerning the location or orientation of either coordinate system, with respect to the other, is needed. The method has additional applications in surveying. Author (TAB)

N66-24898# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
THE VOIGT FUNCTION. AN EIGHT-SIGNIFICANT-FIGURE TABLE AND GENERATING PROCEDURE
D. G. Hummer (Univ. Coll., London) 1965 35 p refs Prepared jointly with Univ. Coll., London Mem. Roy. Astron. Soc., vol. 70, Pt. 1
(Contract AF 29(601)-6013)

In order to satisfy the need for a high precision generating routine for use in obtaining numerical solutions of the radiative transfer equation, a procedure was developed for generating the normalized Voigt function U(a,x) capable of yielding eight or more significant figures. A table was prepared giving U(a,x) to eight significant figures for x=0(0.05)5(0.1)10 and for 25 values of a in the interval $0 \leq a \leq 0.5$. D.T.

N66-24935*# California Univ., Berkeley.
NONLINEAR PROGRAMMING AND OPTIMAL CONTROL
Pravin P. Varaiya Washington, NASA, May 1966 62 p refs
(Grant NsG-354)
(NASA-CR-479) CFSTI: HC $3.00/MF $0.75 CSCL 12A

We have proposed a model optimization problem which is a generalization of the usual nonlinear programming problem. We derive necessary conditions for the solution of our problem. These conditions, under varying interpretations and assumptions, yield the Kuhn-Tucker theorem and the maximum principle. Furthermore, they enable us to devise decomposition techniques for a class of large convex programming problems. We show that there exist sets which well call local cones and local polars which play a determining role in maximization theories which consider only first variations, and that these theories give varying sets of assumptions under which these sets, or relations between them, can be obtained explicitly. Author

N66-24937*# Northrop Space Labs., Huntsville, Ala. Research and Analysis Section.
SIMULTANEOUS SOLUTION OF NON-LINEAR ALGEBRAIC EQUATIONS Technical Memorandum No. 163
Frank B. Tatom, Virginia C. Lillard, and Lalit M. Bhalla 9 Mar. 1966 111 p refs
(Contract NAS8-20183)
(NASA-CR-74771; E-20-177) CFSTI: HC $4.00/MF $0.75 CSCL 12A

This report presents the results of a research effort concerned with the development of a general digital computer program capable of solving sets of nonlinear algebraic equations which are characteristics of filter circuit analysis. The program utilizes a combination of the Newton-Raphson method and the Freudenstein-Roth technique. Results of computer runs involving six equations and unknowns and thirteen equations and unknowns are presented. The report indicates that the computer program developed is capable of solving sets of nonlinear algebraic equations, and the ease with which the solution is achieved is directly related to the accuracy of the initial estimates of the roots to the equations. Author

N66-24964*# Stanford Univ., Calif. Dept. of Statistics.
DENUMERABLE STATE MARKOVIAN DECISION PROCESSES-AVERAGE COST CRITERION Technical Report No. 86
Cyrus Derman 28 Feb. 1966 25 p refs Supported in part by NASA, Army, and AF
(Contract Nonr-225(53))
(NASA-CR-74784) CFSTI: HC $1.00/MF $0.50 CSCL 12B

Markovian decision processes with a countable number of states and average cost criterion are considered. Counterexamples are presented to show that optimal control rules need not exist or if they do exist they may not be of a deterministic stationary Markovian character. Conditions are presented under which optimal rules do exist and are stationary deterministic. Further conditions are presented under which a policy improvement procedure converges to an optimal rule. Author

N66-25020*# Kent State Univ., Ohio.
ON CERTAIN INFORMATION-THEORETIC CONCEPTS IN THE THEORY OF GRAPHS
M. Christine Wilson Washington, NASA, May 1966 47 p refs
(Grant NsG-568)
(NASA-CR-478) CFSTI: HC $2.00/MF $0.50 CSCL 12A

The basic information-theoretical concepts are presented for measuring the amount of information contained in a given experiment. The object is the study of the concept of entropy which is defined as a measure of the amount of uncertainty. The various approaches to the notion of entropy are reviewed, and precise formulations are given for computing the entropy function for (1) the discrete probability distribution, (2) the continuous probability distribution, (3) the generalized probability distribution, and (4) Markov chains. An investigation of the evolution of random graphs is made from the viewpoint of information theory. A graph has been shown by Bhargava to be a reasonable probabilistic model in many applied situations such as group dynamics and communication theory. Time changes in such a graph are described by means of the evolution of a random graph, which in turn is formulated in terms of a stochastic process. Author

N66-25096# Sandia Corp., Albuquerque, N. Mex.
APPLICATIONS OF THE LOG-NORMAL FUNCTION TO THE MASS DENSITY AND NUMBER DENSITY DISTRIBUTION OF SPHERICAL PARTICLES
D. F. Warnke Dec. 1965 27 p refs
(Contract AT(29-1)-789)
(SC-TM-65-397) CFSTI: HC $2.00/MF $0.50

The log-normal distribution is described in terms of mass and number distributions of particles. All of the associated mathematical relations are formulated. An example illustrates the use of log-normal density and distribution function including curves and tables of these functions. An Appendix describes a short FORTRAN program for calculating the probability density functions. Author (NSA)

N66-25212# California Univ., Livermore. Lawrence Radiation Lab.
A NOTE ON PARALLELISM
Maurice Neuman 22 Nov. 1965 31 p ref
(Contract W-7405-ENG-48)
(UCRL-14546) CFSTI: HC $1.00/MF $0.50

The concept of parallelism is presented in a manner which is believed to be in better agreement with the global viewpoint. NSA

N66-25264# Harvard Univ., Cambridge, Mass. Engineering Sciences Lab.
ON THE NUMERICAL SOLUTION OF CERTAIN NONLINEAR INTEGRAL EQUATIONS
Donald G. Anderson Jan. 1966 50 p refs
(Grant NSF GK-65)
(TR-26)

Certain questions of computational strategy are discussed in the context of a class of nonlinear integral equations arising in a kinetic theoretic approach to rarefied gas dynamics. Author

N66-25275# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
A PRIORI INEQUALITIES AND POINTWISE BOUNDS FOR SOLUTION OF CERTAIN ELLIPTIC AND PARABOLIC BOUNDARY VALUE PROBLEMS
V. G. Sigillito Aug. 1965 116 p refs
(Contract NOw-62-0604-c)
(TG-722; AD-630335) CFSTI: HC $4.00/MF $0.75

In this paper a method of Bramble and Payne is used to obtain a priori pointwise bounds at interior points for the solution of (i) the Dirichlet problem for a rather general second order nonlinear parabolic operator; (ii) the first boundary value problem for certain linear fourth order elliptic operators and (iii) the first initial boundary value problem for certain linear fourth order parabolic operators. In addition, a priori bounds for the energy integrals corresponding to the fourth order elliptic operators are derived. Since the bounds obtained are in terms of L_2 integrals of the data (and, for the fourth order operators, derivatives of the data) the Rayleigh-Ritz technique may be employed in the linear problems to obtain close bounds. TAB

N66-25293# Lockheed Missiles and Space Co., Sunnyvale, Calif.
SOLUTION OF EIGENVALUE PROBLEMS BY THE COMPLEMENT VECTOR METHOD
N. N. Kalitkin [1965] 14 p refs Transl. into ENGLISH from Vychislitel'naya Mat. i Mat. Fiz. (USSR), v. 5, no. 6, 1965 p 1107-1115 Presented at All-Union Conf. on Computer Math., 1965

A method is proposed for solution of eigenvalue problems, based on the reduction of the (linear or nonlinear is immaterial) problem to a system of nonlinear algebraic equations. It is an extension of the method of Henny and Wilets formulated for finding only the eigenfunctions. An example of applying the method, of finding the single-electron states of a compressed iron atom, is given. Author

N66-25310*# Pennsylvania State Univ., University Park.
ON THE MICHAILOV CRITERION FOR EXPONENTIAL POLYNOMIALS
Allan M. Krall Washington, NASA, May 1966 20 p refs
(Contract NGR-39-009-041)
(NASA-CR-489) CFSTI: HC $1.00/MF $0.50 CSCL 12A

Consideration is given to an equation of the form

$$F(z) = \sum_{i=1}^{m} \sum_{j=0}^{n} \tilde{a}_{ij} z^j e^{\omega_i z} = 0$$

where $0 \leq \omega_1 < \omega_2 \ldots < \omega_m$ are real numbers and $\tilde{a}_{ij}$, $i=1,\ldots m$, $j=1,\ldots n$ are complex numbers. Assumptions are that there is at least one coefficient a_{ij} different from zero when $i \geq 1$. This equation is then transformed into an equation of the form

$$G(z) = \sum_{i=1}^{m} \sum_{j=0}^{n} a_{ij} z^j e^{-\gamma_i z} = 0 \quad ,$$

and a determination is made of the number of zeros in the right half plane. It is found that G(z) has at most a finite number of zeros all of which lie inside a semicircle of radius M + 1 centered at the origin, and a rigorous proof of this is included. C.T.C.

N66-25311# Joint Publications Research Service, Washington, D.C.
THE MATHEMATICAL APPARATUS OF BIOLOGICAL CYBERNETICS
N. A. Bernstein 12 May 1966 304 p refs Transl. into ENGLISH of the book "Mathematicheskiy Apparat Biologicheskoy Kibernetiki" Moscow, 1964 p 1-374
(JPRS-35470; TT-66-31906) CFSTI: $6.00

This book is an introduction to the mathematical procedures of general cybernetics and offers additional information necessary to work in the area of biological cybernetics. The problems of specific mathematical study of various biological control systems and the processes which occur in the systems are investigated. An analysis of the value of applying the mathematical methods of cybernetics to the solution of various problems in medicine and physiology is offered. Basic information is presented on set theory, functions, probability theory, mathematical statistics, information theory, and the design and operation of control systems. R.N.A.

N66-25374*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE VARIANCE OF SPECTRAL ESTIMATES
Eugene R. Rodemich 31 Mar. 1966 28 p refs
(Contract NAS7-100)
(NASA-CR-74958; JPL-TR-32-892) CFSTI HC $2.00/MF $0.50 CSCL 12A

If the estimate $S(\omega)$ for the spectral density is computed by the use of the function $y(x) = sgn(x)$, and if the spectrum is flat, then the dominant term in the variance of $S(\omega)$ is $1/2\ \pi^2$ K/N. This term is evaluated for nonflat spectra and for more general functions y(x). It is shown in the analysis that the loss in accuracy caused by working with y(x) instead of x itself can be decreased considerably by using, for y(x), a step function with more than two values. D.T.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics and 30 Space Sciences.

N66-23900# American Meteorological Society, Boston, Mass.
THE MAXIMUM RANGE OF RADAR DETECTION OF SHOWERS [O PREDEL'NOI DAL'NOSTI RADIOLOKATSIONNYKH OBNARUZHENII LIVNEVYKH OSADKOV]
G. B. Brylev and E. M. Salman Bedford, Mass., AFCRL, Dec. 1965 12 p ref Transl. into ENGLISH from Gl. Geofizicheskaia Observ., Tr. (Leningrad), no. 159, 1964 p 35-39
(Contract AF 19(628)-3880)
(T-R-533; AD-628967) CFSTI: HC $1.00/MF $0.50

The question of the maximum range of detection of showers by radar is examined. It is found that it depends on the range to the radio horizon and the width of the directional pattern of the antenna. Author (TAB)

N66-23914# American Meteorological Society, Boston, Mass.
NUMERICAL METHODS FOR SOLVING WEATHER-FORECASTING AND CLIMATE-THEORY PROBLEMS, PART I
G. I. Marchuk Dec. 1965 104 p refs Transl. into ENGLISH of the book "Chislennye Metody Resheniia Zadach Prognoza Pogody i Teorii Klimata. Chast' I" Novosibirsk, Redaktsionno-Izd. Otdel Sibirsk. Otd. Akad. Nauk., 1965 101 p
(T-R-520; AD-629009) CFSTI: HC $4.00/MF $0.75

General methods of reducing complicated weather forecasting problems to elementary algorithms are discussed; and elementary algorithms were studied in relation to their possible implementation with computers. A flat earth system of coordinates (x, y, z, and t) is assumed, and all processes in the atmosphere are regarded as adiabatic. Equation systems regarding the dynamics of atmospheric processes are stated; and problems of boundary conditions, turbulence, and other parameters are solved. L.S.

N66-24086# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TRANSACTIONS OF THE ALL-UNION SCIENTIFIC METEOROLOGICAL CONFERENCE Selected Articles
12 Jan. 1966 151 p refs Transl. into ENGLISH from Vses. Nauchn. Meteorol. Soveshch., Fiz. Prizemnogo Sloya (Leningrad), v. VII, 1963 p 3-72, 154-160, 205-215)
(FTD-MT-64-296; AD-628302) CFSTI: HC $14.70/MF $1.00

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2. INFLUENCE OF RADIATIVE HEAT EXCHANGE ON THE TEMPERATURE REGIME OF THE SURFACE LAYER OF THE ATMOSPHERE F. N. Shekhter p 12-28 refs (See N66-24088 13-20)

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7. ON DETERMINING THE COEFFICIENT OF TURBULENCE IN THE BOUNDARY LAYER OF ATMOSPHERE WITH THE THERMAL WIND AND NONSTATIONARINESS OF THE MOTION TAKEN INTO ACCOUNT A. V. Tkachenko p 93–104 refs (See N66-24093 13-20)

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9. ON CERTAIN CHARACTERISTICS OF THE WIND FIELD IN THE LOWER 300-M LAYER OF THE ATMOSPHERE V. N. Ivanov and F. Ya. Klinov p 118–229 (See N66-24095 13-20)

10. STRUCTURE OF AIR FLOW IN THE LOWER 0.5-KILOMETER LAYER P. A. Vorontsov p 130–144 refs (See N66-24096 13-20)

N66-24087# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

TURBULENT CONDITIONS IN THE SURFACE LAYER OF NON-STATIONARY AIR FLOW

S. S. Zilitinkevich *In its* Trans. of the All-Union Sci. Meteorol. Conf. 12 Jan. 1966 p 1–11 refs (See N66-24086 13-20) CFSTI: HC $14.70/MF $1.00

The influence of a nonstationary air flow on the vertical distribution of wind speed and temperature in its surface layer was investigated; and wind and temperature profiles were determined in the surface layer during near equilibrium conditions in the atmosphere. It is pointed out that, based on the results, it is possible to derive formulas for calculating the dynamic speed and vertical eddy heat flux of the air flow from wind and temperature gradient observations. D.T.

N66-24088# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF RADIATIVE HEAT EXCHANGE ON THE TEMPERATURE REGIME OF THE SURFACE LAYER OF THE ATMOSPHERE

F. N. Shekhter *In its* Trans. of the All-Union Sci. Meteorol. Conf. 12 Jan. 1966 p 12–28 refs (See N66-24086 13-20) CFSTI: HC $14.70/MF $1.00

Various theoretical and experimental attempts to determine the role of radiative heat transfer are examined. In the theoretical method, the heat flux equation is solved with a composite calculation of radiant and turbulent heat exchange; in the experimental method, temperature changes, caused by different factors, in the actually existing profiles of the various meteorological elements are determined. It is pointed out that a temperature field developing under the influence of radiative heat transfer is analogous to a background, on which secondary atmospheric processes, with their own influence, also develop. Sometimes, these secondary processes significantly exceed the direct contribution of radiative heat transfer to the temperature field. Based on the examination it is concluded that in constructing a model in which all parameters are found only according to experimental data, it is impossible to obtain correct results without taking into consideration the radiative heat transfer. D.T.

N66-24089# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ANALYSIS OF BASES OF THE PRANDTL-KARMAN SEMI-EMPIRICAL THEORY FROM THE POINT OF VIEW OF THE STRUCTURE OF TURBULENT PULSATIONS IN THE SURFACE LAYER OF THE ATMOSPHERE

A. R. Konstantinov *In its* Trans. of the All-Union Sci. Meteorol. Conf. 12 Jan. 1966 p 29–57 refs (See N66-24086 13-20) CFSTI: HC $14.70/MF $1.00

In an examination of the Prandtl–Karman semi-empirical theory, the calculation of temperature stratification influence on the flow intensity of different substances in a turbulent atmosphere is considered from the point of view of turbulent heat exchange. It is demonstrated that an elementary analysis of the turbulent heat exchange mechanism makes it possible to determine why eddy heat fluxes calculated from an unstable stratification exceed those calculated as a product of the exchange coefficient by the gradient of the mean temperature. The cause of this is the selectivity of the exchange due to which the effective temperature gradients determining the true heat flux exceed the magnitude of the gradients of mean temperature. The effect of turbulent heat exchange selectivity is an increase in the intensity of the heat flux from the soil to the atmosphere. It is concluded that in the semi-empirical theory there are a number of insufficiently rigid assumptions among which is an over simplification of the turbulent processes in the boundary layer, and that only the approximate compensation of these inaccuracies makes the theory applicable, although under limited conditions. D.T.

N66-24090# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THEORY OF THE DIURNAL VARIATION OF THE WIND SPEED IN THE BOUNDARY LAYER OF THE ATMSOPHERE

L. T. Matveyev *In its* Transl. of the All-Union Sci. Meteorol. Conf. 12 Jan. 1966 p 58–72 refs (See N66-24086 13-20) CFSTI: HC $14.70/MF $1.00

Previous theories of the diurnal variation of the wind speed are examined; and a solution is proposed for the partial differential equations of atmospheric motion, from the surface of the earth where the wind speed vanishes to heights where time is no longer a factor, i.e., as in the geostrophic wind. An analysis of the solution shows the possibility of a theoretical explanation of the essential peculiarities of the diurnal variation of the wind speed within the limits of the entire layer, with the condition that the coefficient of turbulence be taken as a function of time and height. In conclusion it is pointed out that diurnal oscillations are observed not only in the boundary layer but also throughout the troposphere. Such oscillations can be calculated if turbulent exchange is considered for the whole troposphere where the turbulent eddies exceed those of the boundary layer by an order of magnitude or more. D.T.

N66-24091# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINING VERTICAL CURRENTS IN THE BOUNDARY LAYER ON THE BASIS OF EXTERNAL PARAMETERS
L. R. Orlenko *In its* Trans. of the All-Union Sci. Meteorol. Conf. 12 Jan. 1966 p 73–83 refs (See N66-24086 13-20) CFSTI: HC $14.70/MF $1.00

Vertical air currents caused by surface friction, heating, and cooling were determined using the continuity equation

$$\delta u/\delta x + \delta v/\delta y + \delta w/\delta z = 0,$$

where u, v, and w are components of the wind speeds along the x, y, and z axes. The determinations were performed based on wind distributions calculated with the atmospheric motion equations. In addition, a qualitative analysis was carried out to determine the influence of each factor on the vertical velocity. Included in this analysis were the effects of the geostrophic wind and atmospheric stratification, as well as surface friction, heating, and cooling. The analysis showed that it is also necessary to take into account the horizontal intensity changes of turbulent heat exchange. D.T.

N66-24092# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON CERTAIN LAW-GOVERNING PRINCIPLES OF THE BOUNDARY LAYER OF THE ATMOSPHERE OBTAINED FROM AN ANALYSIS OF EXPERIMENTAL DATA
I. I. Melent'yeva *In its* Trans. of the All-Union Sci. Meteorol. Conf. 12 Jan. 1966 p 84–92 refs (See N66-24086 13-20) CFSTI: HC $14.70/MF $1.00

A theoretical analysis was performed of wind and temperature distributions, temperature fields, and the earth as a source of heat, water vapor, and momentum in an investigation of the governing principles of the atmospheric boundary layer. The following conclusions were reached: (1) The height of the boundary layer increases with instability from 0.7 km during a stable state to 2-3 km during an unstable state. (2) The boundary layer increases from spring to summer and decreases from autumn to winter. (3) The values of the turbulence coefficient determined as a function of height agree with previous values determined by other methods. (4) The performance of analogous calculations is proposed as a method to determine the physico-geographical laws of vertical turbulence heat exchange. D.T.

N66-24093# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON DETERMINING THE COEFFICIENT OF TURBULENCE IN THE BOUNDARY LAYER OF ATMOSPHERE WITH THE THERMAL WIND AND NONSTATIONARINESS OF THE MOTION TAKEN INTO ACCOUNT
A. V. Tkachenko *In its* Trans. of the All-Union Sci. Meteorol. Conf. 12 Jan. 1966 p 93–104 refs (See N66-24086 13-20) CFSTI: HC $14.70/MF $1.00

A method was developed, based on the use of hodograph equations, for determining the mean coefficient of turbulent viscosity in terms of the vertical wind profile, taking into account the thermal wind and nonstationary air flow. The hodograph equations were derived from the partial differential equations for atmosphere motion. It is pointed out that the conditions, under which this method may be applied, are observed 70% of the time. D.T.

N66-24094# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
VERTICAL PROFILE OF THE COEFFICIENT OF TURBULENCE IN THE BOUNDARY LAYER OF THE ATMOSPHERE
M. I. Ruzin *In its* Trans. of the All-Union Sci. Meteorol. Conf. 12 Jan. 1966 p 105–117 refs (See N66-24086 13-20) CFSTI: HC $14.70/MF $1.00

An approximate solution is presented for the problem of the vertical distribution of the turbulence characteristics in the boundary layer. The results of the theoretical calculation of the turbulent heat exchange coefficient are compared with the results determined from aerological observations of the wind and pressure fields. The analysis shows that the maximum and mean values of the turbulence coefficient and the height increase with a weakening in motion stability. D.T.

N66-24095# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON CERTAIN CHARACTERISTICS OF THE WIND FIELD IN THE LOWER 300-M OF THE ATMOSPHERE
V. N. Ivanov and F. Ya. Klinov *In its* Trans. of the All-Union Sci. Meteorol. Conf. 12 Jan. 1966 p 118–229 (See N66-24086 13-20) CFSTI: HC $14.70/MF $1.00

In a study of turbulent mixing and turbulent air flow, and the distribution of the mean wind velocity, measurements were made of wind velocity changes with time at varying heights up to 300 m. Based on the measurements the following were determined: the degree of air flow perturbation; the magnitude of turbulence intensity; and the magnitude of the longitudinal turbulent energy component of speed on a unit mass. In addition, the Eulerian longitudinal correlation functions were calculated for each measuring height; these were used to evaluate the horizontal dimensions of nonhomogeneities. D.T.

N66-24096# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STRUCTURE OF AIR FLOW IN THE LOWER 0.5-KILOMETER LAYER
P. A. Vorontsov *In its* Trans. of the All-Union Sci. Meteorol. Conf. 12 Jan. 1966 p 130–144 refs (See N66-24086 13-20) CFSTI: HC $14.70/MF $1.00

A captive, suspended aerostat was used to study the air flow structures and the thermodynamic states of the boundary layer. The longitudinal component of wind speed pulsations was evaluated for each thermodynamic state in the 500 m layer. Maximum values of change in velocity were obtained at velocities greater than 7 m/sec and at changes in temperature greater than 1 deg; minimum values were obtained in the layers of a surface inversion. The frequencies of velocity change, the maximum values of velocity change, and the vertical components of the velocity were determined for winds with average speeds of 5 and 10 m/sec. It was found that the air flow is near laminar in a surface inversion with low wind speeds. The average characteristics of air flow structures with varying intensities were investigated; and the temperatures, changes in temperature, and the turbulent exchange coefficients were evaluated for the different structures. D.T.

N66-24334# Norwegian Meteorological Inst., Blindern.
STATISTICAL-DYNAMICAL METEOROLOGICAL PREDICTIONS. Final Report
Ragnar Fjortoft, ed. Nov. 1965 181 p refs (Contract AF 61(052)-374)
(AFCRL-66-113; AD-628820) CFSTI: HC $17.80/MF $1.00

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N66-24335# Norwegian Meteorological Inst., Blindern.

LARGE-SCALE SPECTRAL ENERGY CHANGES IN BAROTROPIC AND BAROCLINIC MOTIONS

Ragnar Fjortoft *In its* Statist.-Dynamical Meteorol. Predictions Nov. 1965 34 p refs (See N66-24334 13-20) CFSTI: HC $17.80/MF $1.00

(TN-3)

The problem of spectral energy fluxes in barotropic motions was considered. Some supplementary considerations are presented, together with an example from the atmosphere. In another paper, the condition for a free conversion of potential into kinetic energy, in geostrophically balanced flow, was studied, assuming temperature to change according to advection. In this report vertical velocities are included in the adiabatic equation. The importance of non-linear interactions between temperature- and velocity fields, for the formation of disturbances, is studied. Author

N66-24336# Norwegian Meteorological Inst., Blindern.

ON THE ROLE OF DIFFERENTIAL HEATING FOR THE MAINTENANCE OF THE LONG WAVES

Ragnar Fjortoft *In its* Statist.-Dynamical Meteorol. Predictions Nov. 1965 16 p refs (See N66-24334 13-20) CFSTI: HC $17.80/MF $1.00

The external control of the energy levels in the atmosphere was discussed. The discussion has been extended to cover the case with a large-scale forced differential heating due to oceans and continents. In particular the relative roles are discussed of the force differential heating and the heating caused by advection, with special emphasis on the kinematical parameters which are important in this connection. A comparison between theory and observations has been undertaken. Author

N66-24337# Norwegian Meteorological Inst., Blindern.

STATISTICAL-DYNAMICAL METEOROLOGICAL PREDICTIONS Summary Report

Ragnar Fjortoft and Jack Nordo *In its* Statis.-Dynamical Meteorol. Predictions Nov. 1965 45 p refs (See N66-24334 13-20) CFSTI: HC $17.80/MF $1.00

The level of energy balance in the atmosphere was studied, on a hemispheric scale, and the results are summarized. Based on the U.S. Weather Bureau historical weather maps from the Northern Hemisphere, the data read are daily surface pressure and 500 mb contour heights. Daily values of various quantities related to zonal means and the corresponding eddies were computed and tabulated for latitudinal zones of varying width. Formulas are derived for various energy quantities and horizontal scale parameters, and computations were carried out to determine their mean values, standard deviations, persistence correlations, and their internal correlations. Lag and cross correlations are tabulated, and it is pointed out that the energy quantities derived at a mid-tropospheric level correlate poorly with energy quantities derived at the surface. The most persistent quantities are generally the zonal energies at 500 mb and eddy variance and eddy scale at the surface. M.G.J.

N66-24338# Norwegian Meteorological Inst., Blindern.

A STUDY OF THE PREDICTABILITY OF A 28-VARIABLE ATMOSPHERIC MODEL

Edward N. Lorenz *In its* Statist.-Dynamical Meteorol. Predictions Nov. 1965 14 p refs Repr. from Tellus (Stockholm), v. 17, no. 3, 1965 321–333 (See N66-24334 13-20) CFSTI: HC $17.80/MF $1.00

A 28-variable model of the atmosphere is constructed by expanding the equations of a two-level geostrophic model in truncated double-Fourier series. The model includes the nonlinear interactions among disturbances of three different wavelengths. Nonperiodic time-dependent solutions are determined by numerical integration. By comparing separate solutions with slightly different initial conditions, the growth rate of small initial errors is studied. The time required for errors comparable to observational errors in the atmosphere to grow to intolerable errors is strongly dependent upon the current circulation pattern, and varies from a few days to a few weeks. Some statistical predictability of certain quantities seems to be present even after errors in the complete circulation pattern are no longer small. The feasibility of performing similar studies with much larger atmospheric models is considered. Author

N66-24339# Norwegian Meteorological Inst., Blindern.

SIGNIFICANCE OF REGRESSION EQUATIONS DERIVED FROM SERIALLY CORRELATED DATA, AND A PROCEDURE OF SELECTING OPTIMAL PREDICTORS

Jack Nordo *In its* Statist.-Dynamical Meteorol. Predictions Nov. 1965 20 p refs (See N66-24334 13-20) CFSTI: HC $17.80/MF $1.00

(TN-1)

In this paper we discuss the significance of statistical parameters derived from serially correlated data. We propose also a procedure of selecting optimal predictors. It is suggested that this procedure will be more efficient than some of those in operational use. Author

N66-24341# Norwegian Meteorological Inst., Blindern.

ON THE INTEGRATION OF A SYSTEM OF GEOSTROPHICALLY BALANCED PROGNOSTIC EQUATIONS

Ragnar Fjortoft *In its* Statist.-Dynamical Meteorol. Predictions Nov. 1965 7 p refs Presented at the Intern. Symp. on Numerical Weather Prediction, Tokyo, 7–13 Nov. 1960 Repr. from the Symp. Proc., p 153–158 (See N66-24334 13-20) CFSTI: HC $17.80/MF $1.00

(TN-2)

Details are given on studies undertaken to determine what differences can be expected in the integration results when

the quite general geostrophic prognostic equations are used instead of the more simplified versions which have been applied previously. A series of equations are formulated and the differences between them, in regard to the derivatives for pressure, vertical stability, etc., are delineated. The integration problem is examined, and the disadvantages of certain equations are discussed, with alternative methods of solutions proposed. M.G.J.

N66-24479# Geophysics Corp. of America, Bedford, Mass. GCA Technology Div.

LOCAL VORTICES ASSOCIATED WITH A VOLCANO Final Report

Edward M. Brooks Sep. 1965 24 p refs (GCA-TR-65-13-G)

The Surtlein volcano, located SSW of Vestmann Island, was surveyed to assess it as a possible outdoor laboratory for the study of local vortices, namely waterspouts and loop clouds. The complicated circulation in and around the volcano, formed by a succession of erupting geysers and their attendant cumiliform cloud formations and drifts, were observed with field glasses from a safe distance. The relative rates at which the tops of the geyser clouds rose revealed that a cloud with the strongest updraft was usually the one associated with a new geyser. Maximal vertical motion appeared when the geyser erupted from the vent. Loop clouds formed below the plume only when the cloud at the base of a weakening geyser was entrained backwards and upwards into the stronger geyser behind it. A visible waterspout formed below a geyser only when the geyser was detached from the vent, and when the next geyser was a considerable distance upwind from the geyser cloud from which the waterspout formed. G.G.

N66-24538# Joint Publications Research Service, Washington, D. C.

TRANSLATIONS FROM METEOROLOGY AND HYDROLOGY, NO. 3

26 Apr. 1965 96 p refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 3, Mar. 1966 p 10–17, 26–44, 49–62 (JPRS-35188; TT-66-31625) CFSTI: $3.00

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N66-24539# Joint Publications Research Service, Washington, D. C.

AUTOMATIC PLOTTING OF ISOLINES ON MAPS OF METEOROLOGICAL FIELDS

E. I. Nizhnikov and A. N. Bagrov *In its* Transl. from Meteorology and Hydrol., No. 3 26 Apr. 1966 p 1–10 refs (See N66-24538 13-20) CFSTI: $3.00

An algorithm for a universal program is described by which meteorological fields are calculated in a computer for subsequent plotting on maps. A two-coordinate recording instrument (DRP) is used; the instrument is supplied with a special converter, which converts the digital code into continuous voltages. It is assumed that in the units of a certain regular grid the values of the geopotential are given. To plot the isolines of the geopotential, it is necessary to (1) calculate, with adequate frequency, the coordinates of the points on the map through which the isoline passes, and (2) place these coordinates in the machine storage in sequence so that, after connecting these points by small segments of a straight line, a continuous line is formed. The logic program includes a subprogram for calculating the coordinates of the isoline for the given values of the geopotential and compiling tables for these coordinates, and a subprogram for sorting the tables of coordinates and reducing them to a sequence necessary for continous plotting of the isolines. Formulas are derived, and a sample problem is included. M.G.J.

N66-24540# Joint Publications Research Service, Washington, D. C.

ZONAL CIRCULATION IN EQUATORIAL LATITUDES

L. I. Litvinenko *In its* Transl. from Meteorology and Hydrol., No. 3 26 Apr. 1966 p 11–22 refs (See N66-24538 13-20) CFSTI: $3.00

In order to obtain a clear concept of the distribution of zonal currents in the upper troposphere and lower stratosphere of the low altitudes, maps of the zonal component directions of wind velocity were analyzed. For the periods under consideration, it was concluded: (1) Westerly winds are observed much more frequently in the upper troposphere of the equatorial zone than was considered usual. (2) Zonal air currents in the lower troposphere are basically small. (3) The nonuniform zonal circulation regime in different longitudes is explained to a considerable degree by the difference of the underlying surface, and not merely by the difference in the circulation processes. M.G.J.

N66-24541# Joint Publications Research Service, Washington, D. C.

ON THE STRUCTURE OF STRATIFORM CLOUDS

B. P. Bysik *In its* Transl. from Meteorology and Hydrol., No. 3 26 Apr. 1966 p 23–30 refs (See N66-24538 13-20) CFSTI: $3.00

Low stratiform clouds and the theory of their formation were studied, with dynamic and radiation factors considered. Formulas were derived to determine transfer and redistribution of water vapor in turbulent mixing, and in the presence of vertical air currents. Stratiform cloud materials from aircraft ascents were used in the investigation; clouds with an upper boundary below 2.5 km were selected. Based on the findings, it was concluded: (1) The origin of stratiform clouds, from the viewpoint of the turbulent transfer theory, depends upon the dimensionless quantity $L=wH/k$. As L increases, the condensation process in the upper part of the mixing layer intensifies, and vice versa. (2) In winter, stratiform clouds are accompanied by a rise in temperature at the surface of the earth. (3) In the temperate zone, the overwhelming majority of the clouds are supercooled. (4) Within the cloud layer, a decrease in temperature occurs in time, caused by heat radiation from the upper surface of the clouds. (5) The upper boundary of the clouds is always located essentially lower in winter than in other seasons. M.G.J.

N66-24542# Joint Publications Research Service, Washington, D. C.

ON THE OBJECTIVE ANALYSIS OF ATMOSPHERIC FRONTS ON A SURFACE WEATHER MAP

E. I. Kostyryachenko *In its* Transl. from Meteorology and Hydrol., No. 3 26 Apr. 1966 p 31–35 ref (See N66-24538 13-20) CFSTI: $3.00

Studies undertaken to find comparatively simple parameters for determining the position of the lines of atmospheric fronts on surface weather maps are discussed. Calculations were performed on almost all meteorological elements represented on the weather maps by quantitative values. Besides the isolines of each characteristic on the maps being analyzed, the isolines of various combinations of these characteristics were drawn. The position of the isolines, and of the axes of the troughs and crests of these isolines, were also compared with the position of the lines of the atmospheric fronts on the map. Formulas were derived, and the results compared with unanalyzed material. From the findings, it was concluded that the accuracy of the front zone in the pressure field depended on the accurate interpretation of the regular grid squares. M.G.J.

N66-24543# Joint Publications Research Service, Washington, D. C.

A METHOD OF CALCULATING THE H_{500} GEOPOTENTIAL FOR THE NATURAL SYNOPTIC PERIOD

E. I. Mepistsveridze *In its* Transl. from Meteorology and Hydrol., No. 3 26 Apr. 1966 p 36–44 refs (See N66-24538 13-20) CFSTI: $3.00

A method is discussed, which considers the meridional processes over Europe, for calculating the H_{500} geopotential for the natural synoptic period during the winter months. A diagram was constructed, which is used in operational work for compiling long range weather forecasts before forecast phenomenon occurs. The analysis of the diagram is discussed and the refinements made are reviewed. The newly constructed diagram allows for consideration of the processes in the troposphere and lower stratosphere simultaneously and the distribution of the convective heat flow in the mid troposphere, thereby providing the opportunity to introduce a correction into the forecasts calculated according to the diagram. H.S.W.

N66-24544# Joint Publications Research Service, Washington, D. C.

INVESTIGATION OF THE TURBULENCE OF THE ATMOSPHERE BY MEANS OF AN ACOUSTIC ANEMOMETER

V. N. Ivanov and Yu. B. Burakov *In its* Transl. from Meteorology and Hydrol., No. 3 26 Apr. 1966 p 45–53 refs (See N66-24538 13-20) CFSTI: $3.00

It is stated that in the development of acoustic anemometers to perform stationary measurements of wind velocity pulsations, one basic difficulty is the lack of small-sized and comparatively simple high frequency electroacoustic converters. A description is given of an electroacoustic converter which contains piezoceramic elements made of lead zirconate–titanate. The design of this converter is discussed and the electrical circuitry of the anemometer is described. By using this acoustic anemometer, it is reported that determinations may be made of the turbulent energies of the vertical pulsation components, the longitudinal pulsation components of the wind velocity in addition to the tangential friction. The determination of these quantities required the use of an analog system and a block diagram and a discussion of this measuring and processing system is provided. H.S.W.

N66-24545# Joint Publications Research Service, Washington, D. C.

AEROVISUAL OBSERVATIONS OF GRAIN-CROP CONDITIONS

G. I. Borisoglebskiy *In its* Transl. from Meteorology and Hydrol., No. 3 26 Apr. 1966 p 54–58 ref (See N66-24538 13-20) CFSTI: $3.00

The procedures used for aerial inspection of grain crops in the Soviet Union are described. The criteria that are used to perform an evaluation of each grain field are discussed and the results of these surveys are assessed. H.S.W.

N66-24566# Joint Publications Research Service, Washington, D. C.

RECENT DEVELOPMENTS IN METEOROLOGY AND HYDROLOGY

9 Mar. 1966 109 p refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 1, 1966 p 3–38, 48–51 (JPRS-34465; TT-66-30905) CFSTI: $3.00

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7. DETERMINATION OF THE KINETIC ENERGY OF CYCLONES AND ANTICYCLONES N. I. Pavlov p 58–59 ref (See N66-24573 13-20)

8. RELATIONSHIP BETWEEN OUTGOING THERMAL RADIATION AND THE MEAN TEMPERATURE FIELD OF THE TROPOSPHERE AND LOWER STRATOSPHERE K. Ya. Kondrat'yev p 60–66 refs (See N66-24574 13-20)

N66-24567# Joint Publications Research Service, Washington, D. C.

CHARACTERISTICS OF ATMOSPHERIC CIRCULATION IN THE "PREWINTER" NATURAL SYNOPTIC SEASON

S. T. Pagava *In its* Recent Develop. in Meteorology and Hydrol. 9 Mar. 1966 p 1–11 refs (See N66-24566 13-13) CFSTI: $3.00

This article presents the results of an investigation of the relationship between some seasonal changes of atmospheric circulation in the stratosphere in the northern hemisphere, the natural synoptic season of prewinter in the troposphere for the first natural synoptic region, and the characteristics of the temperature field of the water surface layer in the North Atlantic. Author

N66-24568# Joint Publications Research Service, Washington, D. C.

EFFECT OF SOLAR ACTIVITY ON TEMPERATURE AND CIRCULATION CHANGES IN THE STRATOSPHERE

Kh. P. Pogosyan and A. A. Pavlovskaya *In its* Recent Develop. in Meteorology and Hydrol. 9 Mar. 1966 p 12–23 refs (See N66-24566 13-13) CFSTI: $3.00

Studies were conducted to trace synchronous changes of solar activity and air temperature at heights of 25 to 30 km using observational data for the cold months October through March for the years 1957/1958, 1962/1963, and 1963/1964. By using these years it was possible to compare the temperature changes in the stratosphere with solar activity changes in the period of its maximum (1958) and its minimum (1964). These same years were characterized by the largest changes in temperature and circulation in the stratosphere. No direct relationships were found between solar processes and processes in the stratosphere for either high or low activity years. A comparison between specific chromospheric flares and temperature changes in the stratosphere was also made but with no detectable relationship. The sun's effects on the atmosphere are numerous and this is apparently the reason why attempts to determine solar-tropospheric relationships have been unsuccessful. R.N.A.

N66-24571# Joint Publications Research Service, Washington, D. C.

AIR CURRENTS NEAR THE EQUATOR AND AIR EXCHANGE BETWEEN HEMISPHERES IN 1963–1964

Yu. S. Petrovskiy *In its* Recent Develop. in Meteorology and Hydrol. 9 Mar. 1966 p 40–52 refs (See N66-24566 13-13) CFSTI: $3.00

This study showed that in air exchange between hemispheres, the principal role was played by air transfer in the lower half of the troposphere from the winter to the summer hemisphere. In the upper troposphere there was an opposite transfer of air masses from the summer to the winter hemisphere. Air exchange between hemisphere in the lower stratosphere was several times less than in the troposphere. In 40% of the cases studied, the trade winds crossed the equator, mostly from the winter to summer hemisphere. In the case of strong anticyclogenesis in the northwestern part of the Pacific Ocean, conditions are created in the central part of the ocean which are favorable for the penetration of the northeast trade winds into the southern hemisphere to 20°S. Sometimes the trade winds crossed the equatorial low and in the southern hemisphere the transfer of air occurred against the pressure gradient. In the central part of the Pacific Ocean of the northern hemisphere during summer, the resultant transfer was almost absent in both upper and lower troposphere. This was apparently the result of a frequent change in the direction of transfer. R.N.A.

N66-24572# Joint Publications Research Service, Washington, D. C.

INTERACTION BETWEEN THE UPPER AND LOWER ATMOSPHERIC LAYERS

L. R. Rakipova *In its* Recent Develop. in Meteorology and Hydrol. 9 Mar. 1966 p 53–57 refs (See N66-24566 13-13) CFSTI: $3.00

An examination is made of the influence of disturbances in the upper layers of the atmosphere on the circulation of the troposphere in the polar region. This is considered during the spring change of circulation and during so-called sudden stratospheric warmings. Solutions are obtained by investigating a system of motion, continuity, and heat flux equation in a cylindrical coordinate system, under the assumption that the temperature changes linearly with height outside the disturbance. The major conclusion is that the initial state of circulation in the entire thickness of the atmosphere is dependent on heat fluxes in the upper atmosphere and on solar activity. C.T.C.

N66-24573# Joint Publications Research Service, Washington, D.C.

DETERMINATION OF THE KINETIC ENERGY OF CYCLONES AND ANTICYCLONES

N. I. Pavlov *In its* Recent Develop. in Meteorology and Hydrol. 9 Mar. 1966 p 58–59 ref (See N66-24566 13-13) CFSTI: $3.00

A determination is made of the kinetic energy of cyclones and anticyclones by considering a triple integral formula for the kinetic energy of an air mass of circular form on a synoptic chart. A comparison is made of the kinetic energy of two circular pressure systems, and it is shown that this energy can be judged from the change of the square of the number of closed isobars. C.T.C.

N66-24574# Joint Publications Research Service, Washington, D. C.

RELATIONSHIP BETWEEN OUTGOING THERMAL RADIATION AND THE MEAN TEMPERATURE FIELD OF THE TROPOSPHERE AND LOWER STRATOSPHERE

K. Ya. Kondrat'yev *In its* Recent Develop. in Meteorology and Hydrol. 9 Mar. 1966 p 60–66 refs (See N66-24566 13-13) CFSTI: $3.00

In connection with the analysis of outgoing atmospheric radiation measurements by meteorological satellites, methods have been investigated to determine atmospheric temperature. This article briefly discusses some of the results obtained in this field which can be applied to the interpretation of already available data. Results indicate that even simple measurements of outgoing radiation by means of a radiometer supplied with light filters are extremely promising from the viewpoint of determining the temperature of different layers of the atmosphere. R.N.A.

N66-24658# Joint Publications Research Service, Washington, D. C.

TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY. NO. 307: EXPERIENCES ON THE USE OF 500 MILLIBAR 48-HOUR NUMERICAL FORECASTING CHART AT THE METEOROLOGICAL OBSERVATORY OF CENTRAL METEOROLOGICAL BUREAU

Ju-Kuei Shen and Wei-Feng Mou 6 Apr. 1966 28 p Transl. into ENGLISH from Ch'i-Hsiang Hsueh-Pao (Peking), v. 30, no. 4, Nov. 1965 p 383–397 (JPRS-34925, TT-66-31363) CFSTI: $1.00

Experiences on the use of 500 mb 48-hour numerical forecasting charts during 1964–1965 by the meteorological observatory of Central Meteorological Bureau is evaluated. Based on experience on numerical forecasting during the past three years, this paper emphasizes the deviation of numerical forecasting under different weather conditions. The discussion is intended to provide understanding and information on the capability and to promote effective utilization of numerical forecasting. Author

N66-24721# Litton Systems, Inc., St. Paul, Minn. Applied Science Div.
SKYHOOK BALLOON FLIGHTS, FLIN FLON, MANITOBA, CANADA: FLIGHTS 3006 N THRU 3013 N AND 3015 N AND 3016 N, AUGUST 18-SEPTEMBER 18, 1964
T. E. O'Malley and R. M. Dungan 10 Dec. 1964 92 p
(Contract Nonr-4567(00))
(Rept.-2650; AD-610109) CFSTI: HC $3.00/MF $0.75

The report discusses the planning and execution of a series of balloon flights from Flin Flon, Manitoba, Canada, in August and September of 1964. A total of ten flights carrying gamma ray detectors and associated scientific and balloon control instrumentation were flown. TAB

N66-24753# Geophysics Corp. of America, Bedford, Mass.
METEOROLOGICAL INFERENCES FROM RADIANCE MEASUREMENTS Final Report
Jean I. F. King Mar. 1965 44 p refs
(Contract CwB-10883)
(GCA-TR-65-6-G)

A nonlinear inversion algorithm was used to deduce the atmospheric thermal profile from radiance data taken at 100,000 ft during a balloon flight on Sept. 11, 1964 launched from Palestine, Texas. Detailed calculations showed that it was possible to infer atmospheric temperature structure from multichannel radiance data of two to three decimal accuracy; and that the algorithm applied without prior smoothing to noisy data produces the maximum allowable inferences consistent with the accuracy of the data. The following four thermal structure features can be inferred: 1) stratosphere lapse-rate, 2) tropopause pressure and temperature, 3) troposphere lapse-rate, and 4) lower bound (cloud or surface) pressure and temperature. The limit on permissible inferred structure is set by the accuracy of the data. Thus, increasing individual channel sensitivity is more important than adding to the number of channels. Other comments on the deduction are also given. L.S.

N66-24761# Chicago Univ., Ill. Dept. of the Geophysical Sciences.
SOME CHARACTERISTIC FEATURES OF WINTER CIRCULATION IN THE TROPOSPHERE AND LOWER STRATOSPHERE
K. Miyakoda Dec. 1963 143 p refs
(Grant NSF-GP-471)
(TR-14)

Using temperature and geopotential data of January 1958 from 1000-mb to 25-mb level, the mean state and the time variation of the winter atmosphere are studied. Vertical velocity was computed by dynamical and adiabatic methods. The monthly averaged meridional circulation obtained reveals three cells in the troposphere and two indirect cells in the lower stratosphere with the downward current at 50°N latitude. January circulation is marked by explosive warming around the polar-night jet and blocking in the troposphere; the former occurs simultaneously with extreme cooling in the troposphere. By investigating time evolutions of vertical velocity, kinetic energy, and available potential energy, the dynamics of both phenomena are examined. In explosive warming, the vertical flux of geopotential energy through the tropopause and also the baroclinic effect play a major role in producing hemispheric wave number two or three. Final breakdown seems to occur when the wave develops sufficiently and the flow pattern starts to move eastward. In blocking, the kinetic energy which has reached its maximum diminishes very rapidly at first, and then cellular waves develop. Author

N66-24785# Library of Congress, Washington, D. C. Aerospace Information Div.
NATIONAL WEATHER SERVICE, USSR; COLLECTION OF REPORTS
1965 145 p refs
(AID-62-3A; TT-65-64091; AD-622024) CFSTI: HC $4.00/MF $1.00

Contents: Relationship of the national weather service to the military weather service; Structure of the agencies providing weather service to the Soviet armed forces; Organization of the agency providing weather service to the Soviet army; Forty years of the Soviet Hydrometeorological Service; Correct evaluation of meteorological conditions; Cooperation between civil and military; Methods of compiling 3-7-day weather forecasts; Present state of Soviet climatology; Automation of meteorological work; Air weather service; Gas composition of the earth's atmosphere; Arrangement of the meteorological network; Conference on transparency and visibility; Evaluation of conditions for high-altitude flight; Rockets and satellites and the investigation of the upper atmosphere; Kotel'nikov theorem and the study of geophysical phenomena; Popularization of hydrometeorological knowledge; Satellites and atmospheric optical research; Aerological and polar drifting stations; and Weather control: Conference on weather modification, Artificial activation of clouds and fog. TAB

N66-24813# American Meteorological Society, Boston, Mass.
NON-STATIONARY TURBULENT REGIME IN THE SURFACE LAYER OF THE ATMOSPHERE [NESTATSIONARNYI TURBULENTNYI REZHIM V PRIZEMNOM SLOE ATMOSFERY]
S. S. Zilitinkevich Bedford, Mass., AFCRL, Dec. 1965 21 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 127, 1962 p 3-13
(Contract AF 19(628)-3880)
(T-R-487; TT-66-60677; AD-628972) CFSTI: HC $1.00/MF $0.50

Regularities in the vertical distribution of wind and temperature are ascertained for nonstationary conditions in a region of small values of dimensionless height. The problem of the quasi-stationary transformation of the temperature field is studied as a function of changes in the shortwave insolation. The relationships obtained can be used in forecasting.
Author (TAB)

N66-24847# Oklahoma Univ., Norman.
NIMBUS CLOUD PICTURES AS AN ANALYSIS AID OF HURRICANE "DORA" (1964)
John W. Gallion (M.S. Thesis) 1966 74 p refs
(Grants NSF G-172; CWB-WBG-57)
(AD-478246)

The possibility of correlating picture density with tropical storm intensity was investigated. The major variables—subject contrast, lighting ratio, exposure time, and degree of development—which affect picture density are discussed; and the analytical method is described, along with the selection of pictures and grids for the analysis. The storm parameters under investigation were mean relative humidity, low level height anomalies, isotach, high level and middle level temperature anomalies, divergence, and mean storm vorticity. Good picture density correlations were obtained with low level height anomalies, isotach, and middle level temperature anomalies. It is concluded that the determination of storm intensity from satellite photographs is feasible. D.T.

N66-24851# Texas A&M Univ., College Station.
THE USE OF SATELLITE CLOUD PICTURES TO DETERMINE AVERAGE RELATIVE HUMIDITY BELOW 500 MB
Philip Walter West (M.S. Thesis) Jan. 1966 68 p refs
(Contract AF 33(608)-1284)
(AD-478369)

This study describes an attempt to obtain a statistical relationship between clouds and average relative humidity. The important types of cloud observations are conventional surface observations and satellite television pictures. The conventional cloud observations for radiosonde stations adjacent to the Gulf of Mexico and the western Caribbean Sea were first correlated with the average relative humidity for the column below 500 mb at each radiosonde station. While a definite relationship was found, the corresponding correlation coefficient did not reveal appreciable significance. Satellite TV cloud observations were classified according to a system developed for the purpose. A relationship with a significant correlation was found for a short period of summer data. Examples are presented to show a suggested average relative humidity analysis based on observations made from meteorological satellites over the waters adjacent to the southeastern United States. Author (TAB)

N66-24858# Missouri Univ., Columbia.
A STUDY OF NOCTURNAL THUNDERSTORMS AND THEIR RELATION TO JET STREAM INTERSECTIONS
Lowell Thomas Cooke (M.S. Thesis) Jan. 1966 87 p refs
(Contract AF 33(608)-1254)
(AD-478410)

This account is intended to point out how very isolated nocturnal thunderstorms can be, the difficulty of observing them unless they occur near a reporting station and, as the following paragraph indicates, the lack of any obvious synoptic clues that would alert a forecaster to the possibility of their occurrence. The only synoptic conditions noted, were: (1) the presence of a horizontal low level wind maximum at approximately 4000 feet MSL oriented nearly north-south with speeds of about 35 knots, located between Schilling AFB, and Russell, Kansas (60 miles west of Schilling); (2) reports of moderate to severe turbulence between 2000 and 3500 feet above the ground by several B-47 type aircraft in the vicinity of Schilling AFB; (3) at 300 millibars at 0600 CST a southwest-northeast jet stream was located over central Kansas. A study of previous 300 millibar maps showed that a wind speed maximum had moved northeastward from central New Mexico during past 12 hours and was located over cental Kansas at 0600 CST. (4) As previously mentioned the absence of any surface fronts or troughs aloft. TAB

N66-24955*# Stanford Research Inst., Menlo Park, Calif. Aerophysics Lab.
PROBABILITY DISTRIBUTIONS OF PRECIPITATION-SCATTER INTERFERENCE Final Report
Roy H. Blackmer, Jr. Apr. 1966 74 p refs
(Contract NASR-49(23))
(NASA-CR-74778) CFSTI: HC $3.00/MF $0.75 CSCL 04B

Meteorological data at and in the vicinity of Portland, Maine, have been analyzed to assess the probability distributions of radio interference received via forward scatter of radiation by precipitation. This precipitation-scatter interference has been expressed in terms of an effective interference temperature for comparision with magnitudes of sky temperature and receiver noise temperatures. It was found that with a standardized value of interfering power of one picowatt per square meter per cycle per second, values of interference temperature could be as high as 10^5K. Probability distributions, by season, of various magnitudes of interference temperature are presented both for the condition in which the interfering signal is present at all altitudes and that in which it is only present above various specific altitudes. A comparison is made between the probability distributions of interference temperature and the probable values of sky temperature. In these comparisons it is shown that during periods of precipitation the sky temperature increases less rapidly with rainfall rate than does interference temperature. Author

N66-25372*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PRELIMINARY RESULTS OF ANEMOMETER COMPARISON TESTS
Dennis W. Camp 26 Apr. 1966 34 p refs
(NASA-TM-X-53451) CFSTI: HC $2.00/MF $0.50 CSCL 04B

Mean wind speed and wind speed variance obtained by use of anemometers were compared. The preliminary results of this comparison, which was made using statistical, spectral, and relative techniques, show that any of the anemometers will give a good estimation of wind speed. Although the differences in the wind data obtained by the anemometers are pointed out, no attempt was made to specify a best anemometer, if one exists. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N66-24531# Joint Publications Research Service, Washington, D. C.
ALGORITHMIZATION OF THE PROCESSES OF CONTROL OF AIR TRAFFIC
V. M. Leshchenko *In its* Autom. Operational Management of Processes of Production 8 Apr. 1966 p 254-261 refs
(See N66-24515 13-10) CFSTI: $7.00

Based on the results of theoretical and experimental investigations, analysis of the dynamic properties of airplanes as objects of control show that, in algorithms for automatic air navigation problems, only the movement of centers of mass should be considered. It is also pointed out that in the automatic control of air movement, solutions should be presented in the form of analytical dependences, which can be reduced to two types: (1) bringing the airplanes out into fixed points of space in a given time interval; and (2) prevention of planes falling into conflict situations. It is pointed out that the complexity of the equations and the accuracy of the solution of navigation and control problems depend substantially on the selected system of coordinates. The factors to be considered are listed, and examples are given. M.G.J.

N66-24532# Joint Publications Research Service, Washington, D. C.
THE APPLICATION OF METHODS OF MASS SERVICING THEORY FOR THE INVESTIGATION OF AIR TRAFFIC

A. I. Volevach *In its* Autom. Operational Management of Processes of Production 8 Apr. 1966 p 262–270 refs (See N66-24515 13-10) CFSTI: $7.00

Based on a survey of air traffic control, it was shown that many of the problems coincide with the problems considered in mass servicing theory. The algorithms constructed to realize the given flows and to model the processes of the servicing system functions are used for multiple reproduction of a random process under the fixed conditions of the problem: traffic intensity, and the dispersion of aircraft deviations from the schedule. The application of the Monte Carlo method for solving the problem of traffic density is examined. A block diagram of the system under consideration is shown, the problem is formulated, and the algorithm is presented. It is pointed out that in the complete automation of all processes for servicing aircraft, validation of the optimum parameters of the system in all stages is necessary, and that the inputs of individual points of the servicing are composed of the outputs of a group of neighboring points. In the overall plan, if the system of servicing aircraft is regarded as a whole, the problem can be solved by modeling on computers by the method of statistical tests. M.G.J.

N66-25107# Sandia Corp., Albuquerque, N. Mex.
PERFORMANCE AND APPLICATIONS OF A MINIATURE ROLL STABILIZED GYRO PLATFORM
N. F. Sinnott and R. O. Rasmussen (Whitaker Corp., Chatsworth, Calif.) Oct. 1965 9 p ref
(Contract AT(29-1)-789)
(SC-R-65-1023) CFSTI: HC $1.00/MF $0.50

A new gyroscopic attitude reference device, called a Roll Stabilized Gyro Platform or Miniature Attitude Reference System, was developed for use on spin stabilized rocket vehicles. The construction and design of the system is described, followed by a discussion of error factors and over-all accuracy of the system. This new gyro system fills the void between low cost standard free gyro assemblies and the sophisticated but costly inertial platform systems. It offers additional performance features that are useful in telemetry applications which are described. Several examples are discussed, of how the roll stabilized gyro platform functioned in typical flight tests of spinning rocket vehicles. Author (NSA)

N66-25168# Federal Aviation Agency, Oklahoma City, Okla. Office of Aviation Medicine.
PROBLEMS IN AIR TRAFFIC MANAGEMENT. VII: JOB AND TRAINING PERFORMANCE OF AIR TRAFFIC CONTROL SPECIALISTS—MEASUREMENT, STRUCTURE, AND PREDICTION
David K. Trites, M. Clinton Miller, and Bart B. Cobb Jul. 1965 21 p refs
(AM-65-22)

A statistical study of training- and job-performance measures of several hundred Air Traffic Control Specialists (ATCS) revealed that training-performance measures reflected: (1) performance in the training laboratories; (2) academic performance; and (3) instructors' opinions. In the job-performance area, supervisors seemed to be evaluating (1) overall performance of an ATCS; (2) his interpersonal orientation; (3) job orientation; (4) job potential; (5) job performance; and (6) emotional stability. By examining the practicability of the job-performance measures by training performance, aptitude tests, previous job-relevant experience, and demographic characteristics, evidence was elicited that: (1) the ATCS specialties differ in the characteristics required for job performance; (2) terminal supervisors more consistently evaluated their ATCS in comparison with enroute supervisors; (3) opinions of the ATCS training-course instructors are the best predictors of subsequent job performance; and (4) aptitude tests, previous job-relevant experience, and age at entry into training are related to job performance but not at very high levels. Author

N66-25186# General Electric Co., Philadelphia, Pa.
AN INVESTIGATION OF THE PROPERTIES OF A REPETITIVELY FIRED TWO-STAGE COAXIAL PLASMA ENGINE
Per Gloersen, Bernard Gorowitz, Warren A. Hovis, Jr., and Richard B. Thomas, Jr. Apr. 1962 29 p refs
(R62SD28)

A repetitively fired two-stage coaxial plasma engine has been successfully operated in a 3×13 foot test chamber under conditions closely simulating those of outer space. The operating principles of the two-stage engine are described in detail, along with the advantages obtained with a two-stage approach. Results of some preliminary measurements of pressure distribution in the engine, thrust, specific impulse, input mass flow, and energy efficiency are presented. In addition, a photoelectric spectrum mapping technique has been developed which takes advantage of the repetitive nature of the pulsed plasma exhaust. This technique has been used to obtain emission spectra from various points inside and beyond the muzzle of the two-stage gun, and has been successful in yielding many more spectral lines than the standard photographic technique. Generally, the results have been that only argon ion and oxygen ion lines appear in all parts of the gun and in the exhaust. Most notable in their absence are the copper and silicon ion lines, which had appeared in the exhaust of an earlier single-stage self-triggered coaxial gun, and which indicate erosion of the electrodes and insulators, respectively. Author

N66-25190# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Institut für Flugfunk und Mikrowellen.
TRANSMISSION OF CHARACTERISTIC DATA AND DISTANCE MEASUREMENT IN AIRPLANES
Th. Feger Dec. 1965 49 p refs In GERMAN; ENGLISH summary
(DLR-FB-65-63; DVL-429) CFSTI: HC $2.00/MF $0.50

Within the scope of general studies on the automatization of air-traffic control, a simple system for measuring the distance between ground control station and airplane, and a system for data relay from airplane to ground station was developed. The operating principles of these systems have been tested, and this report describes the technical details of the test arrangements for both systems. It includes, in addition, system-analytical studies on possibilities and practicability of these accessory devices in present and future air-traffic control systems. Author

N66-25252# International Business Machines Corp., Owego, N. Y. Federal Systems Div.
EVALUATION AND ERROR ANALYSIS OF THE DDA TRANSFORMATION MATRIX COMPUTER FOR STRAP DOWN INERTIAL SYSTEMS
G. A. Harasty 10 Jun. 1964 70 p refs
(IBM-64-550-018)

An evaluation and error analysis are made of the DDA high speed transformation matrix computer for a strapped-down inertial system. This computer is used to solve simultaneous differential equations in real time with a high degree of accuracy. These are used in creating a space stable inertial reference frame using digital incremental outputs from pulse

rebalance inertial instruments fixed along the vehicle axes. The DDA design objectives are established, and computational requirements imposed by strapped-down inertial system applications are considered. A suitable mathematical technique for expressing the transformation is suggested, and various incremental computing algorithms are presented. A description is given of special effects and anomalies that arise in the computations, and an error analysis to relate significant design parameters to expected computational errors is performed. A general DDA design procedure integrated with the error analysis to meet the design objectives is outlined. C.T.C.

N66-25384# Naval Oceanographic Office, Washington, D. C.
WAVE HINDCAST PROJECT, NORTH ATLANTIC OCEAN Final Technical Report
Donald C. Bunting Jan. 1966 43 p refs
(TR-183; AD-630431) Available from Naval Oceanog. Office, Washington, D. C.: $0.75; CFSTI: MF $0.50

A computerized system has been developed for the production of ocean wave spectra over the North Atlantic Ocean. The spectra results are fairly close to observed conditions. By means of this system a 15-month series of wave spectra has been obtained at 519 gridpoints over the North Atlantic. Each spectrum is described in terms of the spectral energy in 12 directions for 15 different frequencies. Author (TAB)

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N66-23931# Naval Radiological Defense Lab., San Francisco, Calif.
PULSED REACTOR SIMULATION OF UNDERWATER NUCLEAR DETONATIONS—THERMAL ANALYSIS
Y. E. Schrock 9 Apr. 1965 33 p refs
(USNRDL-TR-940; AD-629404) CFSTI: HC $3.60/MF $0.50

Pulsed reactor facilities provide, in a short time interval, a copius supply of neutrons which can be used in small-scale experiments to simulate some of the aspects of underwater nuclear detonations. Calculations have been made, using reasonable approximations, to estimate the degree of vaporization, if any, which would result when a small U-235 sphere is irradiated in a pulsed reactor facility. Conditions considered were a 10-mg sphere immersed in water (and in vacuum) and irradiated with a reactor period of 2 ms, resulting in a total fission energy deposition of 16 calories (2×10^{12} fissions). Results of these calculations indicate complete vaporization of the U-235 bead in a vacuum environment, with a peak temperature of between 13,900° and 28,800°K. This temperature is limited by expansion, radiation heat loss, and condensation of U-235 on the walls of the vacuum vessel. In the water environment, the bead would be vaporized, with peak temperature above 7000°K, resulting in complete chemical reaction with water vapor and the release of an additional 5.1 calories of heat. Again, radiation, condensation and expansion limit the temperature. The final state of fuel and fission products is expected to be finely divided oxides suspended in liquid water, if not free molecules. Hydrogen will be generated (1.9 ml at STP). Author (TAB)

N66-23946# AiResearch Mfg. Co., Los Angeles, Calif.
587-KVA 24,000-RPM ALTERNATOR, PART NO. 546136-1-1 Final Technical Report
F. B. Mc Carty and S. Tarhov 28 Dec. 1965 47 p
(Contract DA-44-009-ENG-5251)
(F-4341, Rev. 1; AD-629562) CFSTI: HC $4.60/MF $0.50

The report includes the description of the alternator, installation and operation instructions, and development test data needed to ascertain the capability of the machine. The testing conducted was undertaken to verify the attainment of the design objectives for this machine. Operation of the alternator at full load conditions was not conducted because available laboratory equipment was not adequate for such a high power level. TAB

N66-24048# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RESEARCH IN DOSIMETRY AND SHIELDING ON THE OIYal SYNCHROCYCLOTRON
In its Probl. of Radiation Safety of Space Flights. Phys. and Biol. Invest. with High-energy Proton 27 Dec. 1965 p 21-50 refs (See N66-24046 13-04) CFSTI: HC $22.70/MF $1.25

Radiation stability of polymer materials was studied in a synchrocyclotron with a Co^{60} radiation source. Various plastics that could be used in spaceship designs and protective devices were irradiated simultaneously, and subsequent measurements of their physical and mechanical characteristics were evaluated. Analyses of the obtained data showed that most materials retained their strength with absorbed doses of up to 30–40 Mrad; radiation stability of glass plastics was higher than that of thermoplastics. Pentone and polyformaldehyde did not withstand radiation effects. Glass plastics showed equal sensitivity to proton and γ-radiation with identical structural changes. G.G.

N66-24266# Atomic Energy Commission, Chicago, Ill.
PROCEEDINGS OF SODIUM COMPONENTS DEVELOPMENT PROGRAM INFORMATION MEETING, CHICAGO, ILLINOIS, JUNE 16–17, 1965
[1965] 310 p refs
(CONF-650620) CFSTI: HC $3.00/MF $1.50

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4. EVALUATION OF NON FUEL MATERIAL BEHAVIOR IN HNPF R. K. Wagner and J. D. Stearns (Atomics Intern.) p 47–84 refs (See N66-24270 13-22)

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8. THE UNITED KINGDOM LIQUID METAL DEVELOPMENT PROGRAMME P. B. F. Evans (United Kingdom Atomic Energy Authority) p 133–142 refs (See N66-24274 13-22)

9. A CEA-EURATOM CONTRIBUTION TO THE SODIUM TECHNOLOGY M. G. Robin (Commissariat a l'Energie Atomique) p 143–155 refs (See N66-24275 13-22)

10. INTERATOM ACTIVITIES IN THE FIELD OF SODIUM TECHNOLOGY R. Harde (Intern. Atomreaktorbau Gesellschaft) p 156–165 refs (See N66-24276 13-22)

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13. SODIUM HEATED STEAM GENERATOR DESIGN AND MATERIALS EXAMINATION OF A MODEL STEAM GENERATOR E. Fortner, D. W. Koch, P. J. Kovach, and P. B. Probert (Babcock and Wilcox Co.) p 204–231 (See N66-24279 13-22)

14. REVIEW OF ATOMIC POWER DEVELOPMENT ASSOCIATES' SODIUM–WATER REACTION PROGRAM H. O. Muenchow p 232–243

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17. THE LIQUID METAL OXYGEN METER B. Minushkin (United Nuclear Corp.) p 271–275 refs (See N66-24281 13-14)

18. EXAMINATION OF THE FERMI COLD TRAP J. Herb (Westinghouse Elec. Corp.) p 276–280 (See N66-24282 13-22)

N66-24268# General Electric Co., San Jose, Calif. Atomic Products Div.

GENERAL ELECTRIC SODIUM MASS TRANSFER PROGRAM

R. S. Young and R. W. Lockhart *In* AEC Proc. of Sodium Components Develop. Program Inform. Meeting, Chicago, Ill., Jan. 16–17, 1965 [1965] p 18–35 refs (See N66-24266 13-22) CFSTI: HC $3.00/MF $1.50

This report describes the status of a study being conducted on mass transfer and corrosion of materials in flowing sodium. The study is involved in evaluating the use of candidate materials in sodium cooled reactors in non-nuclear loop tests, and in developing a means of predicting corrosion or mass transfer rates in full sized systems. Included are discussions of the mass transfer results, localized corrosion effects, and corrosion mock-ups for large sodium systems. R.N.A.

N66-24270# Atomics International, Canoga Park, Calif.

EVALUATION OF NON FUEL MATERIAL BEHAVIOR IN [illegible]PF

R. K. Wagner and J. D. Stearns *In* AEC Proc. of Sodium Components Develop. Program Inform. Meeting, Chicago, Ill., Jun. 16–17, 1965 [1965] p 47–84 refs (See N66-24266 13-22) CFSTI: HC $3.00/MF $1.50 (Contract AT(11-1)-GEN-8)

The Hallam Nuclear Power Facility consists of a 240 Mwt sodium graphite reactor and associated equipment for generating electrical power. In operating the facility, a few instances have developed which required evaluation of some of the non-fuel materials. This article describes the examination conducted to determine the cause of a failed sodium expansion tank. Included are discussions and descriptions of the corrosion of the expansion tank, the tank appearance after failure, an outline of the failure analysis, the nondestructive tests performed, the metallographic examination, the chemical analyses, and the stress analysis. It was concluded that the primary leak that developed in the expansion tank was caused by stress-corrosion cracking. The cracking occurred in an area of high stress where a cavity containing a highly corrosive deposit existed. The deposit was identified as residual flux from coated welding electrodes. A secondary leak developed in the wall of the overflow nozzle as a result of gross attack by the sodium reaction products produced from the sodium released through the primary leak. R.N.A.

N66-24271# Atomic Powder Development Associates, Inc., Detroit, Mich.

FERMI MATERIALS EXPERIENCE

A. A. Shoudy, Jr., B. P. Brown, L. R. Kovac, and W. E. Mc Hugh *In* AEC Proc. of Sodium Components Develop. Program Inform. Meeting, Chicago, Ill., Jun. 16–17, 1965 [1965] p 85–104 refs (See N66-24266 13-22) CFSTI: HC $3.00/MF $1.50

This paper attempts to update the materials experience with Fermi fast breeder reactor components. In particular, emphasis is placed on sodium compatibility experience in the Fermi plant, under-sodium bearing experience, and boronated graphite irradiation test work. R.N.A.

N66-24272# Atomics International, Canoga Park, Calif.

EVALUATION OF THE PERFORMANCE OF MATERIALS IN SODIUM IN THE SRE

D. A. Mannas *In* AEC Proc. of Sodium Components Develop. Program Inform. Meeting, Chicago, Ill., Jun. 16–17, 1965 [1965] p 105–126 refs (See N66-24266 13-22) CFSTI: HC $3.00/MF $1.50

This report describes the results of an examination conducted to determine the effect of a sodium environment on the heat transfer system materials of the Sodium Reactor Experiment (SRE). The SRE sodium heat transfer system was subjected to a wide variety of operating conditions during its seven year period, but there was no indication of an impeding functional failure, nor evidence of cracking or erosion. Detection of Fe, Cr, and Ni in thin film deposits of slight surface irregularities in the hot leg imply that corrosion may have occurred, but only to a slight degree. Carbonaceous deposits in the hot leg indicate that sodium had been saturated with carbon since the introduction of tetralin into the system. Carburization in the main primary piping was not significant in terms of carbon content or case thickness. The layer found in the cold leg appears to be a morphological change along the stainless steel surface. The layer was non-brittle and its high hardness may have prevented eductor nozzle erosion. Considering the severest case of any of the material changes observed in the sodium heat transfer system, the system can be expected to have a reliable life expectancy in excess of 30 years. R.N.A.

N66-24273# Argonne National Lab., Ill.
EBR-II MATERIALS EXPERIENCE
C. H. Schaibelhut *In* AEC Proc. of Sodium Components Develop. Program Inform. Meeting, Chicago, Ill., Jun. 16–17, 1965 [1965] p 127–132 (See N66-24266-13-22) CFSTI: HC $3.00/MF $1.50

This paper attempts to update the materials experience with the Experimental Breeder Reactor II. The reactor's secondary sodium heat transfer system is described followed by a discussion of some component failures associated with material selection. R.N.A.

N66-24274# United Kingdom Atomic Energy Authority, Risley (England).
THE UNITED KINGDOM LIQUID METAL DEVELOPMENT PROGRAMME
P. B. F. Evans *In* AEC Proc. of Sodium Components Develop. Program Inform. Meeting, Chicago, Ill., Jun. 16–17, 1965 [1965] p 133–142 refs (See N66-24266 13-22) CFSTI: HC $3.00/MF $1.50

This article discusses the design studies and the engineering development program for a sodium cooled fast reactor fueled with uranium-plutonium dioxide for an electricity generating system. Included are descriptions of test facilities, rigs, and instrumentation used for developing the reactor components. R.N.A.

N66-24275# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Section des Metaux Liquides.
A CEA-EURATOM CONTRIBUTION TO THE SODIUM TECHNOLOGY
M. G. Robin *In* AEC Proc. of Sodium Components Develop. Program Inform. Meeting, Chicago, Ill., Jun. 16–17, 1965 [1965] p 143–155 refs (See N66-24266 13-22) CFSTI: HC $3.00/MF $1.50

This article briefly describes French efforts in sodium technology using a 20 MWt plutonium fueled fast reactor to develop components. A few indications on experimental sodium heat transfer coefficients are given following by a discussion of experience gained on liquid metal heated steam generators, and in connection with this steam generator program, NaK-water reaction experiments. R.N.A.

N66-24276# Internationale Atomreaktorbau Gesellschaft, Bernsberg (West Germany).
INTERATOM ACTIVITIES IN THE FIELD OF SODIUM TECHNOLOGY
R. Harde *In* AEC Proc. of Sodium Components Develop. Program Inform. Meeting, Chicago, Ill., Jun. 16–17, 1965 [1965] p 156–165 refs (See N66-24266 13-22) CFSTI: HC $3.00/MF $1.50

In connection with INTERATOM activities in sodium technology, this presentation discusses some aspects of the use of carbon stabilized low alloy ferritic steel in high temperature sodium systems and steam generator safety problems. In particular, the experience gained at INTERATOM during the construction and startup of a ferritic steel 5 MW component test facility and an outline of the results of sodium-water interaction experiments are reported. R.N.A.

N66-24277# Atomics International, Canoga Park, Calif.
SODIUM COMPONENT TEST INSTALLATION
J. A. Leppard *In* AEC Proc. of Sodium Components Develop. Program Inform. Meeting, Chicago, Ill., Jun. 16–17, 1965 [1965] p 166–177 (See N66-24266 13-22) CFSTI: HC $3.00/MF $1.50
(Contract AT(11-1)-GEN-8)

This paper briefly reviews some of the salient features of the Sodium Component Test Installation, reports on its activities of the last year, indicates the current status of the plant, and describes the activities planned for the next year. R.N.A.

N66-24278# Atomics International, Canoga Park, Calif.
MODULAR STEAM GENERATOR FABRICATION
L. T. Bogaert and D. F. Casey *In* AEC Proc. of Sodium Components Develop. Program Inform. Meeting, Chicago, Ill., Jun. 16–17, 1965 [1965] p 178–203 refs (See N66-24266 13-22) CFSTI: HC $3.00/MF $1.50
(Contract AT(11-1)-GEN-8)

This report describes the fabrication techniques developed for two evaporator and two superheater modular steam generators for use with sodium cooled reactors. During fabrication of the steam generators, areas for change or improvement in the design, as pertinent to producibility, were demonstrated. Tooling requirements were defined, equipment needs established, and fabrication and inspection procedures determined. With the design and fabrication changes, the modular steam generator concept lends itself well to production techniques. The use of production techniques, repetitive operations, ease of handling, and design simplicity, all indicate that the generator can be produced economically. The tube sheet weld configuration is more costly but can be overcome by production machining practices. Welding costs are about the same as for a tube configuration. Inspection is more costly because of radiography, but the weld quality confidence is increased. Radiography inspection also provides advantages in a crevice free joint, improved tubesheet design, and reliability. R.N.A.

N66-24279# Babcock and Wilcox Co., Lynchburg, Va.
SODIUM HEATED STEAM GENERATOR DESIGN AND MATERIALS EXAMINATION OF A MODEL STEAM GENERATOR
E. Fortner, D. W. Koch, P. J. Kovach, and P. B. Probert *In* AEC Proc. of Sodium Components Develop. Program Inform. Meeting, Chicago, Ill., Jun. 16–17, 1965 [1965] p 204–231 (See N66-24266 13-22) CFSTI: HC $3.00/MF $1.50

The completed preliminary designs of the full-size steam generator and the prototype steam generator are described. A test program to assess the compatibility of Croloy 2-1/4 and 316 stainless steel, particularly with reference to the design parameters of the full size steam generator, is described. Results of a metallurgical examination of piping removed from a model sodium heated steam generator during intermediate shutdown after 1000, 2000, and 4000 operating hours are presented. Author

N66-24280# Atomic Power Development Associates, Inc., Detroit, Mich.
SODIUM TECHNOLOGY LOOP EVALUATION OF IN-LINE INSTRUMENTS AND PURIFICATION DEVICES

Eugene F. Hill *In* AEC Proc. of Sodium Components Develop. Program Inform. Meeting, Chicago, Ill., Jun. 16–17, 1965 [1965] p 255–270 refs (See N66-24266 13-22) CFSTI: HC $3.00/MF $1.50

This paper describes recent additions to the sodium technology loop and supporting facilities for evaluating in-line instruments and purification devices for sodium impurities. The status of the instruments and devices being evaluated in the loop and the supporting chemistry program are discussed. The sodium technology loop was modified to include two additional Rhometers, four oxygen meter cells, a filter cascade, a hydroclone, and improved sodium and cover gas sampling facilities. These additional tools have increased the scope of the investigations which can be undertaken and have allowed a comparison of the relative behavior of these devices under controlled conditions. The techniques used in a chemical laboratory program, to provide an immediate and accurate evaluation of the instrument or clean-up device performance during its development, are described. R.N.A.

N66-24282# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.

EXAMINATION OF THE FERMI COLD TRAP

J. Herb *In* AEC Proc. of Sodium Components Develop. Program Inform. Meeting, Chicago, Ill., Jun. 16–17, 1965 [1965] p 276–280 (See N66-24266 13-22) CFSTI: HC $3.00/MF $1.50

The non-radioactive primary sodium cold trap from the Fermi atomic power plant was examined to determine the chemical and physical composition of the trap contents, to determine the spatial distribution of the chemical species in the trap and their physical form, to evaluate the operational performance of the trap with particular regard to maldistribution of flow and flow bypassing, and to develop criteria for cold trap design. The trap was found to contain fifty pounds of oxygen, one pound of carbon, and lesser amounts of nitrogen, hydrogen, and metallic impurities. The horizontal distribution of impurities was relatively flat. Metallic impurities in the cold trap were examined by emission spectrography and the results are tabulated. The cold trap inner wall was severely collapsed around half its circumference. The most likely explanation was that a layer of sodium oxide had accumulated in the lower mesh and allowed more than 1 psi of pump pressure to be applied across the inner wall causing it to collapse. There was no evidence of flow maldistribution. R.N.A.

N66-24315# European Atomic Energy Community, Brussels (Belgium). Chemistry Dept.

DESIGN CONSIDERATIONS AND CALCULATIONS FOR A Li^6 SEMICONDUCTOR SANDWICH FAST NEUTRON SPECTROMETER EXPERIMENT

R. A. Rydin Feb. 1966 30 p refs
(EUR-2712.e) CFSTI: HC $2.00/MF $0.50

A semiconductor sandwich fast neutron spectrometer, using lithium 6 as the sensitive material, is considered for use in a fission neutron type spectrometer having a thermal neutron component. Calculations were made of the true coincidence background spectrum produced by reactions in the silicon of the discriminator settings. Calculations were also made of the detection efficiency of the spectrometer for a low level discriminator bias set to discriminate against all thermal neutron caused events. Conclusions are: (1) the background response does not appear to limit the use of the spectrometer in a fission type spectrum although it may prove troublesome for other spectra; (2) the background response is large enough to require background subtraction; and (3) loss of efficiency at higher energies due to discrimination of thermal neutron events is not large and can be corrected for. A circuit arrangement, using fast electronics to minimize gamma ray pileup effects, low level discriminators to eliminate thermal neutron response, and a fast gate to minimize true pulse pileup in the microsecond part of the electronic chain, is recommended. Author

N66-24342# Aktiebolaget Atomenergi, Stockholm (Sweden).

TOTAL CROSS SECTIONS OF U, UO_2 AND ThO_2 FOR THERMAL AND SUBTHERMAL NEUTRONS

Samir F. Beshai Mar. 1966 17 p refs
(AE-222) CFSTI: HC $1.00/MF $0.50

The total neutron cross-sections of U, UO_2 and ThO_2 have been measured from 0.0045 eV to 0.028 eV, using the time-of-flight technique. The samples were measured at 20°C. ThO_2 was also measured at 750°C. The neutron source was the reactor R1, Stockholm. The experimental results presented as graphs in the report show in detail the influence of Bragg scattering. The results further show that the increase of the temperature for the ThO_2 sample gives an increase in the cross-section. The work also contains some calculations of the position in energy of Bragg edges for the three materials. These calculations show a very good agreement with the experiments. For uranium metal some calculations have been carried out also for the height (σ_{fel}) of the edges. The agreement with the experiments is reasonable. Author

N66-24412# Aktiebolaget Atomenergi, Stockholm (Sweden).

SWEDISH WORK ON BRITTLE-FRACTURE PROBLEMS IN NUCLEAR REACTOR PRESSURE VESSELS

M. Grounes Mar. 1966 54 p refs
(AE-221) CFSTI: HC $3.00/MF $0.50

The Swedish nuclear energy program, with special attention to reactor pressure vessels, is reviewed. New types of pressure vessel steels with high strength, low transition temperature and good corrosion resistance are being emphasized. These steels are martensitic austenitic types. The brittle-fracture tendancy of pressure vessels is evaluated using the crack propagation transition temperature, as measured by the isothermal crack arrest test. The factors influencing the final transition temperature are discussed, and the final transition temperature for the Marviken reactor is estimated at 115°C. A strain aging study and an irradiation-effects program are in progress. Preliminary results of irradiation on several steels show that the saturation effect varies for different steels, and the effect also varies with the irradiation. Results of experiments on neutron flux and neutron spectra effects show that the neutron spectra differences between materials testing reactors and pressure vessels may be considerable. N.E.N.

N66-24417# European Atomic Energy Community, Brussels (Belgium).

FIRST FLIGHT COLLISION PROBABILITIES IN PIN CLUSTERS AND ROD LATTICES

L. Amyot and P. Benoist (Comm. a l'Energie Atomique, Saclay, France) 1966 30 p refs
(EUR-2751.e) CFSTI: HC $2.00/MF $0.50

A new method of calculation is presented for directional probabilities of interaction in pin clusters and rod lattices. The theory, in principle rigorous from a geometrical point of view, has been programmed for the IBM 7090 as the computer code PROCOPE. Calculation results for Dancoff correction factors and collision probabilities are compared with

N66-25251# Argonne National Lab., Ill.
NUCLEAR-FUEL-ELEMENT LOADING BY VIBRATORY COMPACTION–URANIUM–PLUTONIUM CARBIDE SPECIMENS FOR EBR-II IRRADIATION
J. E. Ayer, F. E. Soppet, G. J. Talaber, and B. H. Bieler Feb. 1966 38 p refs
(Contract W-31-109-ENG-38)
(ANL-7075) CFSTI: $1.00

This report presents the results of fabrication by vibratory compaction of the first of a series of fuel specimens. The uranium–plutonium carbide specimens made for this study were jacketed in eight different alloys. The loading conditions were derived from basic information gathered on a model system. Eleven mixed-carbide rods were made, ten of which were loaded to 80% theoretical density (TD) with 80 w/o uranium carbide and 20 w/o plutonium carbide. The fuel bodies were low in both density and plutonium carbide in the upper 2 in. of the column. One mixed-carbide specimen, compacted to 83.3% TD and containing 19.3% plutonium carbide was more uniform in density and plutonium distribution than the ten based upon the model system. Five fuel specimens containing solid-solution uranium–plutonium carbide were fabricated by the infiltration technique to the highest density practicably attainable. The five specimens showed uniform density and fuel distribution. The density of the fuel columns was 84.2±1.3% of TD attained with 97.1% TD particles compacted into 6.5-mm-ID jackets. Author

N66-25253# Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM Progress Report, Mar. 1966
22 Apr. 1966 120 p refs
(Contract W-31-109-ENG-38)
(ANL-7193) CFSTI: $4.00

Progress is reported with the Experimental Breeder Reactor (EBR-II), the Zero Power Plutonium Reactor (ZPPR), the Zero Power Reactor (ZPR-3), and the Experimental Boiling Water Reactor (EBWR). In the EBR-II area modifications and maintenance to the reactor and plant systems were completed and it is reported that the reactor is operating at 45 MWt. Also reported is that the fuel transfer arm was repaired, and that fuel handling for the current run was routine. The major accomplishment with the ZPPR program was the preparation of specifications for the procurement of fuel elements. A second phase of the SEFOR critical experiments was initiated, and experiments on a two segment core, to measure reactivity changes in a simulated, expanded fuel condition, were completed with the APR-3. In the plutonium recycle program (EBWR) calculations were made of the uniform temperature coefficient of the plutonium critical when poisoned with 5 gm/gal of boric acid by four group, two dimension diffusion theory. The results indicate a positive temperature coefficient between 70° F and 170°F. C.T.C.

N66-25281# National Bureau of Standards, Boulder, Colo. Cryogenic Div.
A COLD MODERATOR REFRIGERATOR INCORPORATING A HIGH SPEED TURBINE EXPANDER
R. O. Voth, M. T. Norton, and W. A. Wilson [1965] 28 p refs
Paper No. C-2 Presented at 1965 Cryog. Eng., Conf., Houston, Tex. 23-25 Aug. 1965
Available from Natl. Bur. of Std., Boulder, Colo.: $1.00

The thermal cycle and high speed gas bearing supported turbine expander chosen for a 1000 watt refrigerator used in a nuclear research program is described. Results of the refrigerator tests under operational conditions are presented. A bearing analysis extends previous work to include the effect of end leakage on the performance of Sixsmith type gas bearings. Author

N66-25331# Oak Ridge National Lab., Tenn.
ISOPOWER—COMPUTER PROGRAM FOR CALCULATING POWER OUTPUT OF SINGLE RADIOISOTOPE OR MIXED RADIONUCLIDE POWER SOURCES
Charles W. Friend and J. R. Knight Dec. 1965 36 p refs
(Contract W-7405-ENG-26)
(ORNL-3828) CFSTI: HC $2.00/MF $0.50

The computer program ISOPOWER calculates the power output of radioisotopes in watts per gram, watts per cubic centimeter, and curies per gram of source. The program sums the contributions to the total power output from all nuclides in a decay chain and from different chains of a mixed radionuclide power source. The results are printed and can be graphed as power output vs time curves on an associated plotter. The program is described, a sample problem is given, and the FORTRAN II calling program listed. Author (NSA)

N66-25332# Aerojet-General Nucleonics, San Ramon, Calif.
ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. BOUNCE, AN IBM 7090 CODE TO CALCULATE FLUX DISTRIBUTIONS WITHIN MULTIPLE-PIN FUEL ELEMENTS BY THE METHOD OF SUCCESSIVE GENERATIONS
T. P. Wilcox Nov. 1965 121 p refs
(Contract AT(10-1)-880)
(AGN-TM-411) CFSTI: HC $4.00/MF $0.75

The BOUNCE code determines the neutron flux distribution within the pin bundle of a multiple-pin fuel element by using the method of successive generations. One energy group is used and all scattering within the pins is considered to be isotropic. Elements with 6, 7, 12, 13, 18, and 19 fuel pins, where each pin is composed of a central fuel pellet surrounded by a cladding material, may be treated by the code. The code neglects the properties of the coolant material around the pins; this, in effect, assumes that the coolant is a gas. The properties of an equivalent solid rod, having the same absorption as the pin bundle, are also determined. The equations of the successive generation method are derived for the case of a solid rod and the multiple-pin fuel element. Comparison between results calculated by the code and those obtained experimentally for twelve 7- and 19-pin elements reveals good agreement. Author (NSA)

N66-25338# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
HIGH VOLUME NONDESTRUCTIVE TEST APPLICATIONS AT THE HANFORD ATOMIC PRODUCTS OPERATION
D. C. Worlton [1964] 22 p refs Presented at IAEA Symp. on Nondestructive Testing in Nucl. Technol., Bucharest
(Contract AT(45-1)-1830)
(BNWL-SA-97; CONF-650509-5) CFSTI: HC $2.00/MF $0.50

The transition from laboratory to field use is discussed from eddy current and ultrasonic testing methods in two fields: inspection of thin-wall tubing, and automatic fuel testing. NSA

N66-25360# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
PULSED HIGH INTENSITY FISSION NEUTRON SOURCES
G. A. Koustad and I. F. Zartman [1965] 159 p refs Proc. of 5 symp. held at AEC, Washington, D. C., Feb. 1965
(CONF-656217) CFSTI: HC $1.75/MF $1.00

values obtained with other methods. The validity of the technique is also checked by evaluating the fine structure of the thermal flux distributions in various gas-cooled clusters upon which measurements have been made at Saclay. As a practical illustration, a series of curves describe the behaviour of the various independent fuel-to-fuel collision probabilities in 19 (or 7) pin gas-cooled clusters. Finally, approximate formulae are given for the pin-to-pin collision probability at both the white and the black limits. Author

N66-24420# United Kingdom Atomic Energy Authority, Windscale (England). Reactor Group.
GRAIN BOUNDARY HOLE IN IRRADIATED URANIUM
W. H. Chatwin and E. D. Hyam 1966 36 p ref
(TRG-325(W)) HMSO: 5s

Growth of grain boundary gas bubbles induced by the intergranular tensile stresses generated by severe thermal cycling during irradiation has been shown to be responsible for the grain boundary cavitation and cracking previously observed in some sepcimens of uranium-1/2 at.% chromium alloy. The mechanism of this process is described in detail. The phenomenon provides one explanation of the pronounced tendency of irradiated uranium to develop grain boundary cracks, with accompanying decrease in apparent density, in certain circumstances in the α range. For irradiated uranium generally, the observations imply that similar intergranular cavitation and cracking, with accompanying changes in dimensions and density, can in principle be produced by any other conditions which cause intergranular tensile stresses provided that these stresses can be maintained for sufficient time at temperature for vacancy diffusion to occur. The little evidence available suggests that this type of structure may only develop under these conditions of thermal cycling at temperatures > 490° C, for irradiation levels ~2000 MWD/te. Author

N66-24442*# Aerojet-General Corp., Azusa, Calif. Von Karman Center.
SNAP-8 MATERIALS REPORT Semiannual Report, 1 Jan.–30 Jun. 1966
H. Derow and B. E. Farwell Jul. 1966 89 p refs *Its* Rept.-3038
(Contract NAS5-417)
(NASA-CR-54719) CFSTI: HC $3.00/MF $0.75 CSCL 18N

Investigations were conducted in support of the design, fabrication, and development testing of various SNAP-8 components. Investigation of a mercury forced-convection corrosion loop was continued with the aim of evaluating the corrosion resistance of 9Cr–1Mo alloy steel (the reference mercury-containment material) for 10,000-hour service. Rubidium is being evaluated as an additive to the mercury to promote boiler conditioning. Data were developed in a continued program to evaluate the effect of the SNAP-8 operating environment on 9Cr–1Mo steel. Author

N66-24451# Atomic Energy of Canada, Ltd., Chalk River, (Ontario).
AECL EXPERIMENTS ON THE CORROSION OF ZIRCONIUM ALLOYS UNDER IRRADIATION
B. Cox May 1966 82 p refs
(AECL-2257) CFSTI: HC $1.50/MF $0.75

The corrosion of zirconium alloys under irradiation has been examined at AECL by exposing corrosion specimens in the water-cooled loops in NRX and NRU reactors. The results of these experiments are reported here and are compared with evidence obtained from the examination of fuel cladding in the same experiments where this is available. The data on Zircaloy-2, the alloy for which most information is available, are compared with the results of experiments elsewhere, and it is concluded that the observations of oxidation and oxygen absorption are influenced considerably by conditions in the specimen's environment. Thus, 'oxidizing' conditions in the loop coolant have often been accompanied by increased weight gains and reduced hydrogen uptake. Under 'reducing' conditions the observed oxide film thickness is normal. Author

N66-24680# Library of Congress, Washington, D. C. Aerospace Technology Div.
STATEMENTS ON SOVIET NUCLEAR REACTOR Surveys of Communist World Scientific and Technical Literature
Bartholomew Poplawski 30 Dec. 1965 41 p refs Compilation of abstracts
(ATD-65-75)

This compilation of abstracts is based on Soviet-Satellite and Western open sources published 1963–1965. The report summarizes the statements and articles related to Soviet-bloc nuclear reactor development programs. The material is arranged according to the following topics: I. Nuclear aerospace propulsion; II. Mobile reactors; III. Marine reactors; IV. New reactor concepts or new reactors being planned or built; V. Utilization of reactors; VI. Ground power reactors and plans; VII. Plans, work, and organization of nuclear related committees and institutes and new institutes or committees for handling nuclear related work. There are a total of 69 entries. Section I discusses nuclear power for aircraft, dirigibles, rockets, and spacecraft as well as a radiation shield for nuclear-powered aircraft. Section II summarizes information on a transportable reactor. Section III covers nuclear power for submarines, icebreakers, and tankers. Section IV discusses types of new reactors. Section V summarizes use of equipment for water desalinization. Section VI covers operations at various atomic power stations. Section VII touches upon atomic research, new experimental installations, development of power engineering, nuclear engineering trends, conferences on atomic energy, and peaceful uses of atomic energy. There is no bibliography. Author

N66-24846# Boeing Co., Seattle, Wash.
AIRBORNE DEBRIS ENVIRONMENTS FROM SURFACE BURST NUCLEAR WEAPONS. Volume I: 80 KILOTON WEAPON YIELD
Stephen J. Fountain 21 Feb. 1966 236 p refs
(D2-84223-1; AD-478065)

Time-spatial distributions have been predicted for the airborne debris from an 80 kiloton nuclear weapon surface burst. The distributions were predicted for zero local wind conditions. These distributions were determined for use in evaluating the vulnerability of launch and reentry vehicles to airborne debris environments. Debris distributions are given along 7 trajectories. These trajectories intercept the earth at mean sea level and at an angle of 20 degrees with respect to the surface. Environments are given for each trajectory at 1, 5, 15, 30, and 60 minutes after the weapon detonation. The environments are given in terms of concentrations (mass per unit volume) for several debris particle-size classes. A total concentration is also given along each trajectory. Author (TAB)

N66-24883# India, Dept. of Atomic Energy, Bombay.
PHYSICS ASPECTS OF LARGE THORIUM FUELLED FAST REACTORS

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N66-25351# Battelle-Northwest, Richland, Wash.
UNDERWATER REFURBISHING OF FUEL ELEMENTS
C. H. Allen and R. E. Sharp Dec. 1965 22 p ref
(Contract AT(45-1)-1830)
(BNWL-174) CFSTI: HC $1.00/MF $0.50

Tools and procedures were developed to make underwater repairs to wire wraps and metal bands for fuel elements. Substantial cost savings have been realized, and new applications have been discovered relative to underwater removal and replacement of fuel rods in the fuel cluster and assembly and disassembly of segmented fuel rods. Author (NSA)

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N66-24019# London Univ. (England). Dept. of Mathematics.
1965 CONFERENCE ON GENERAL RELATIVITY AND GRAVITATION Final Scientific Report
Herman Bondi 13 Dec. 1965 5 p
(Grant AF-EOAR-65-21)
(AD-629098) CFSTI: HC $1.10/MF $0.50

The proceedings of an international conference on general relativity and gravitation are briefly described. The conference covered such topics as a post-Newtonian approximation to relativistic hydrodynamics, gravitational collapse, problems associated with gravitational waves, the focusing effect of a gravitational field on light rays, a new theory of gravitation, a theory of motion equations of test particles, the problem of quantization of the gravitational field, and conservation laws. R.N.A.

N66-24119*# MacNeal-Schwendler Corp., San Marino, Calif.
RELATIVE ENERGY FLUX DENSITIES IN THE PENUMBRAE OF VARIOUS SHADOWING OBJECTS OF ANALYSIS OF THERMAL TEST ERRORS RESULTING FROM IMPERFECTLY COLLIMATED SOLAR SIMULATION BEAMS. APPENDIX B
Edwin J. Gooze and John J. Brooks 21 Mar. 1966 387 p
Prepared for JPL
(Contracts NAS7-100; JPL-951330)
(NASA-CR-74016) CFSTI: HC $7.00/MF $2.00 CSCL 20F

Relative energy flux density data computations are presented for two general configurations of shadow casting objects: black skirts, and black rectangular cylinders. In all cases, the shadowing objects are considered to be infinite in length, with no contribution due to reflection off the shadowing object contained in the data. The two general configurations include other objects as subsets—the black skirt contains the single knife-edge case; the rectangular cylinder contains the double knife-edge, the circular cylinder, and regular polygonal cylinders. The solar field angles are tabulated for 0.5°, 1.0°, 3.0°, 5.0°, 10.0°, and 15.0°; and positive and negative receiver angles from zero to nearly 90° by 10° increments are included. M.G.J.

N66-24232# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
ANALYTIC PROPERTIES OF A CLASS OF POTENTIALS AND THE CORRESPONDING JOST FUNCTIONS
Pierre C. Sabatier Mar. 1966 42 p refs
(TH/140) CFSTI: HC $2.00/MF $0.50

Analytical properties of the potential obtained from phase shifts by Newton's method in the inverse scattering problem at fixed energy were investigated. The analytic continuation of these potentials and of the corresponding Jost functions were examined. It was found that this class of potentials is much more restricted than previously thought. A detailed study of an example is included. It was further shown that the scattering amplitude corresponding to these potentials can be obtained in an exact closed form. N.E.H.

N66-24366*# Harvard Coll. Observatory, Cambridge, Mass.
Shock Tube Spectroscopy Lab.
AUTOIONIZATION EFFECTS IN ULTRAVIOLET ABSORPTION SPECTRA OF HOT GASES Scientific Report No. 6
W. R. S. Garton Nov. 1965 25 p refs
(Grant NsG-438; Contract Nonr-1866(48))
(NASA-CR-74807) CFSTI: HC $1.00/MF $0.50

Autoionization effects present in the ultraviolet absorption spectra of a number of atomic vapours (e.g. of the alkaline earths Ca-Ba, the Group III A elements Al-Tl and those of Group IV B, Si-Pb), are described, and some of the detail is interpreted qualitatively in the framework of the theory of lineshapes ('Beutler-Fano profiles'), recently put forward by Fano. Author (TAB)

R. Shankar Singh 1965 18 p refs Work done in part at Argonne Natl. Lab.
(AEET-229) CFSTI: HC $1.00/MF $0.50

The feasibility of using U^{233}–Th as a fuel in a large fast breeder reactor was studied from the viewpoint of the Doppler and sodium void coefficients. The composition and temperature dependent cross sections for thorium were evaluated using the latest resonance parameters available. The parametric studies indicate that reactivity coefficients due to sodium loss and Doppler effects are negative even in a core volume as large as 15,000 liters. A performance characteristics study of a 15,000-liter, thorium–U^{233}-fueled, sodium cooled fast reactor of the type considered for desalination of sea water was made. Parameters like critical mass, breeding ratio and reactivity coefficients were evaluated for the clean core and for the core with equilibrium composition using metallic and carbide fuels. The interference interaction effect between the resonances of Pu^{239} and Th^{232} on the Doppler effect calculations and the sodium void coefficients in Th–Pu^{239} fueled fast reactors was investigated. The temperature dependent effective cross sections for Pu^{239} and Th^{232} were evaluated. Author

N66-24884# Aktiebolaget Atomenergi, Stockholm (Sweden).
MEASURED AND PREDICTED NEUTRON FLUX DISTRIBUTIONS IN A MATERIAL SURROUNDING A CYLINDRICAL DUCT
J. Nilsson and R. Sandlin Mar. 1966 42 p refs
(AE-220) CFSTI: HC $2.00/MF $0.50

The radial fast neutron flux attenuations in the material (iron) surrounding ducts of diameters 7, 9, and 15 cm and total duct length of about 1.5 m have been investigated with and without neutron scattering cans filled with D_2O in the duct. Experimentally the problem was solved by the use of foil activation techniques. Theoretically it was attacked by, in the first place, a Monte Carlo program specially written for this purpose and utilizing an important sampling technique. In the second place non- and single-scattering removal flux codes were tried, and also simple hand calculations. The Monte Carlo results accounted well for the fast flux attenuation, while the non- and single-scattering methods overestimated the attenuation generally by a factor of 10 or less. Simple hand calculations using three empirical parameters could be fitted to the measured data within a factor of 1.2–1.3 at penetration depths greater than 3–4 cm. The distribution of the D_2O-scattered flux could well be described in terms of single scattering. Author

N66-24931*# Atomics International, Canoga Park, Calif.
TUNGSTEN RESONANCE INTEGRALS AND DOPPLER COEFFICIENTS Third Quarterly Report, Jan.–Mar. 1966
S. G. Carpenter, L. B. Levitt, J. M. Otter, R. K. Paschall, and H. N. Royden 13 May 1966 20 p refs
(Contract NAS3-7982)
(NASA-CR-54954; AI-66-85) CFSTI: HC $1.00/MF $0.50
CSCL 18J

Measurements were made in the 10.6 in lattice of the Sodium Graphite Reactor Critical Assembly (SGRCA), in which the flux spectrum in the resonance region was approximately 1/E; both reactivity and activation methods were used. Multigroup cross sections were calculated for the actual isotopic compositions of the W^{182} and W^{186} samples. From these cross sections and the multigroup and adjoint fluxes, expected reactivities were computed for natural tungsten, W^{182}, W^{186}, and gold. Doppler coefficients were calculated for the three tungsten samples. It is reported that the agreement of these quantities with experiment is as good as could be expected for absolute reactivity calculations. Activation measurements of the W^{186} resonance integral were completed at 293 and 473°K. Reactivity worths and Doppler coefficients of samples enriched in W^{182} W^{186} were measured in the cadmium sleeve at the center of the SGCRA. Reactivities of gold samples with widely varying surface-to-mass ratios were measured to allow absolute calibration of the reactivity measurements. D.T.

N66-24970*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
TUNGSTEN CLADDING OF URANIUM–ZIRCONIUM CARBIDES BY VAPOR DEPOSITION
J. R. Lindgren 8 Mar. 1963 21 p
(Contract NAS3-2532)
(NASA-CR-74885; GAMD-4220) CFSTI: HC $1.00/MF $0.50
CSCL 18J

Tungsten cladding of UC-ZrC specimens of compositions varying from pure UC to 30 a/o UC-70 a/o ZrC has been successfully accomplished. The carbides were found to be extremely reactive in the vapor deposition atmosphere; this required that the gases introduced must be of high purity, and the temperature of initial plating must be kept as low as is practicable to minimize damage to carbides and produce a seal coat. The temperature may then be raised for encapsulation in order to increase the coating rate and enhance the gap bridging capability of the deposition process. Author

N66-25040# Los Alamos Scientific Lab., N. Mex. Health Div.
THE DETERMINATION OF LOW LEVEL PLUTONIUM ACTIVITY: AUTORADIOGRAPHIC TECHNIQUES VS. SCINTILLATION COUNTING
William D. Moss and Evan E. Campbell [1965] 7 p refs Presented at Ann. Bio-Assay Meeting, Albuquerque, N. Mex.
(Contract W-7405-ENG-36)
(LA-DC-7483; CONF-651008-4) CFSTI: HC $1.00/MF $0.50

A comparison was made between autoradiographic techniques and scintillation counting for determination of low level plutonium activity. The human error was considered. As a result the decision was made to return to electronic counting. Reasons for this are: 7 days less time to complete an analysis; less human error; release of a technician from tedious track counting and dark room work; and complete control of contamination to the counters.s NSA

N66-25082*# Aerojet-General Corp., Azusa, Calif.
SNAP-8 ELECTRICAL GENERATING SYSTEM DEVELOPMENT PROGRAM Semiannual Progress Report, 1 Dec. 1964–30 Jun. 1965
Aug. 1965 415 p refs /its Rept.-3053
(Contract NAS5-417)
(NASA-CR-54848) CFSTI: HC $7.15/MF $2.00 CSCL 18N

This report discusses the development progress of the SNAP-8 power conversion system (turbine-alternator assembly, pump-motor assemblies, boiler, condenser, and electrical controls). A 320-hr continuous test in a rated-power test loop was completed. During this test, 50 kw or above was produced throughout a 170-hr period. The turbine-alternator assembly has operated for 830 hr, including 44 starts. Once stable loop operation was achieved, boiler testing was started. Steady-state operation is stable. Author

N66-25066# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Institute für Metallurgie.

COATING OF NUCLEAR FUEL PARTICLES WITH PYROLYTIC CARBON [BESCHICHTUNG VON KERNBRENNSTOFFPARTIKELN MIT PYROLYTISCHEM KOHLENSTOFF]

P. Koss, O. Kofler, H. Maerkl, and K. Wallisch Sep. 1965 27 p refs In GERMAN
(SGAE-M-3/1965)

The preparation of pyrolytic carbon coatings in fluidized beds and in fluidized beds with a central nozzle is described. The efficiency of a fluidized bed with porous plates was investigated. A production installation for the preparation of pyrolytic carbon coatings on nuclear fuel particles is described. The coated fuel particles were tested with respect to surface impurities, fission product permeability, and behavior in action zone. NSA

N66-25070# Atomics International, Canoga Park, Calif.

SNAP REACTOR MATERIALS DEVELOPMENT, SELF-WELD STUDIES

L. G. Kellogg 1 Jun. 1964 57 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9643) CFSTI: HC $3.00/MF $0.75

The test program has been conducted to determine what material combinations have the least adhesion or are least likely to self-weld when they are in contact under load for long periods of time at high temperature and ultrahigh vacuum. Screening tests were conducted on one hundred and ten combinations while in the high-temperature, ultra-high-vacuum environment. The tests cover the temperature range of 700° to 1300°F, with test periods up to 3400 hours in vacuums below 10^{-7} Torr. The screening tests are classified into five basic groups: metal vs metal, metal vs ceramic, metal vs graphite, ceramic vs ceramic, and ceramic vs graphite. A sixth group was added to include the use of contaminant films with the other groups. Adhesion was noted for some combination in all groups tested. The combinations, in which the adhesion force was immeasurable, were assigned an adhesion force equal to the accuracy of measurement (0.1 lb). The data indicate that, in order to minimize adhesion, some contaminant film must be placed between the two surfaces. To simulate the required environmental conditions of the SNAP reactors, it was necessary to design and fabricate a new test facility. The equipment and procedures used are discussed to provide insight into evaluation of the data. Author (NSA)

N66-25071# Mound Lab., Miamisburg, Ohio.

REACTOR FUELS AND MATERIALS DEVELOPMENT—PLUTONIUM RESEARCH: APRIL-JUNE, 1965

L. J. Wittenberg and G. R. Grove 10 Dec. 1965 23 p refs
(Contract AT-33-1-GEN-53)
(MLM-1263) CFSTI: HC $2.00/MF $0.50

The phase equilibria in the Pu-Ce-Fe system was studied. A eutectic valley extends across the diagram at approximately 13 at.% Fe with temperatures in the valley ranging from 411 to 660°C. All of the compounds of the three limiting binary systems display primary phase fields in the ternary system. No ternary compounds exist. As a result of extensive solid solubility, no ternary eutectics occur in the system. The Pu-U system was investigated by differential thermal analysis. The results were essentially in agreement with the literature diagram. The addition of Zr to Pu-U alloys of high U concentration lowers the decomposition temperature of the high temperature, BCC, solid solution phase. Studies of differential thermal analysis thermograms of Pu show that the peaks associated with the $\beta \rightarrow \gamma$, $\gamma \rightarrow \delta$, and $\gamma \rightarrow \beta$ phase transformations in high purity Pu appear more distinctly when the sample is properly annealed. The applicability of a thermal diffusivity measurement technique for measurements of ceramic materials was determined when the thermal diffusivity of a Pyroceram specimen was measured from 200 to 1000°C and compared with previously published values. The density of liquid Pu-22 at.% Ce alloy was measured from 662 to 824°C. The alloy expanded as it transformed from the liquid to the solid state. The viscosity-composition relationship was determined for eleven alloys that spanned the Pu-Ce phase diagram. A viscosity maximum was noted at 5 at.% Ce and a minimum at 14 at.% C. In addition, the liquidus temperature of each alloy was measured precisely. A study was made of the influence of various feed materials on the density of PuO_2 microspheres produced in the induction-coupled plasma torch. The amount and type of porosity in the feed material greatly influenced the quality of the microspheres produced. NSA

N66-25078# Atomics International, Canoga Park, Calif.

EFFECT OF OVERVOLTAGE ON MAIN RELAY BOX STARTUP RELAYS

K. C. Klinkner 10 Jun. 1965 7 p
(Contract AT(11-1)-GEN-8)
(NAA-SR-MEMO-11435) CFSTI: HC $1.00/MF $0.50

A set of SNAP 10A startup relays is subjected to overvoltages up to and including 50 v d-c. The testing is conducted at ambient pressure and temperature. The test voltage is applied to the relay coils for a duration sufficient to insure temperature equilibrium. No catastrophic failures are observed. Author (NSA)

N66-25082# Reactor Centrum Nederland, Petten.

CALCULATION OF THE SAFE LIFE TIME EXPECTANCY OF ZIRCONIUM ALLOY CANNING IN THE FUEL ELEMENTS OF THE NERO REACTOR

A. van der Linde Jul. 1965 40 p refs
(RCN-41)

Based on the present day knowledge of the oxidation and hydridation behavior of Zirconium alloys under PWR conditions a calculation of the safe life time expectancy of Zirconium alloy canning in the fuel elements of the NERO reactor is presented. The decisive NERO conditions for life time calculations are a heat flow of 100 w/cm^2 and a temperature of 348°C at the oxide-water surface. The calculations take account of the increase in oxidation rate under the influence of the heat flow and of the distribution of absorbed hydrogen in the canning wall in the radial direction. The maximum tolerable oxide or oxide+hydride layer thickness, on Zirconium alloy canning tubes, was fixed at 35μ. The calculated data led to the conclusion that from the corrosion point of view the safe life time of Zirconium alloy canning tubes, having a wall thickness of 0.85 mm, operating under NERO conditions is 2.40 years for Zircaloy-2, 3.40 years for Zr-2.5% Nb and Zr-3% Nb-1% Sn, and 3.60 years for Zircaloy-4. Author (NSA)

N66-25083# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).

CURRENT POSITION ON METHODS FOR CALCULATING PLUTONIUM LATTICES [SITUAZIONE ATTUALE DEI METHODI DI CALCOLO DEI RETICOLI CONTENENTI PLUTONIO]

P. Loizzo and L. Tondinelli Jul. 1965 13 p refs In ITALIAN
(RT/FI(65)14)

Six critical experiments in PuO_2 lattices performed at Hanford are calculated with different methods. Author (NSA)

N66-25089# Babcock and Wilcox Co., Lynchburg, Va. Nuclear Development Center.
IRRADIATION PERFORMANCE ON THORIA-URANIA FUEL MATERIALS Final Report
Sep. 1965 279 p refs
(Contract AT(30-1)-3376)
(BAW-3376-4) CFSTI: HC $6.00/MF $1.50

The permeability coefficient of compacted ThO_2–UO_2 fuel specimens was measured from room temperature to 800° C. The gas flow was identified as a combination of Knudsen and viscous flow. Thermal transpiration varied as a function of pressure, decreasing to a low value of above-atmospheric pressures. The sorbed gas release from sol-gel ThO_2–UO_2 fuels, containing to 10% UO_2, increased with increasing UO_2 content. The gas released from the sol-gel fuel varied from a minumum of 0.002 cc/gm for coarse particles to a maximum of 6.1 cc/gm for pulverized materials. The gas released from the fuels consisted of Ar, CO, CO_2, H_2, CH_4, N_2, O_2, and water vapor. A device for simulating a temperature gradient in an operating fuel rod for thermal conductivity measurements was assembled and operated successfully. Post-test examinations of the specimens revealed altered grain structures, simulating those observed in specimens after irradiation at high power. The thermal conductivities measured for UO_2 and ThO_2–UO_2 agree well with published data for a temperature range of 800 to 1800°C. Isothermal grain–growth studies of 2 and 10% UO_2 in ThO_2 resulted in consistent grain growth as a function of temperature for the 2% material. After prolonged exposure (16 hrs) at 2227°C, the ThO_2–10 UO_2 apparently underwent recrystallization. The design concepts for in-reactor measurements of the irradiated fuel thermal conductivity and of the static and dynamic fission gas release are described.
NSA

N66-25097# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
AEROSPACE NUCLEAR SAFETY INVESTIGATIONS OF REENTRY ABLATION PHENOMENA Quarterly Report, 1 Aug.–31 Oct. 1965
J. L. Beal, W. R. Brown, R. L. Pleuthner, and J. F. Newton Oct. 1965 58 p refs Prepared for Sandia Corp.
(Contract AT(29-1)-789)
(SC-DC-65-1893) CFSTI: HC $3.00/MF $0.75

The size distribution as determined by target impact is given for debris particles formed in a shock tunnel test from excessive sized liquid zirconium drops. Tests of zirconium hydride under reentry conditions simulated in the Mach 6 section of the Wave Superheater Hypersonic Tunnel are described. The determination of emissivity during an ablation test is reported.
Author (NSA)

N66-25101# Battelle-Northwest, Richland, Wash.
ADDITIONAL CRACK PROPAGATION TESTS ON ZIRCALOY-2 REACTOR PRESSURE TUBES
R. C. Aungst 20 Sep. 1965 26 p refs Presented at the Electrochem. Soc. Conf. on Zirconium and its Alloys, Buffalo, 10-14 Oct. 1965 Submitted for Publication
(Contract AT(45-1)-1830)
(BNWL-SA-179; CONF-651017-3) CFSTI: HC $2.00/MF $0.50

A reproducible drop-weight test was developed to test the nil ductility transformation temperature of Zircaloy-2 pressure tubing using specimens cut from the tube wall. Results of fracture tests on slotted tube specimens covering a wide range of temperatures were used to construct a fracture analysis diagram. A discussion of the test results is presented.
NSA

N66-25110# Harvard School of Public Health, Boston, Mass.
PROPOSED GAS AND AIR CLEANING SYSTEMS FOR ROVER ENGINE TEST STANDS (WITH SPECIAL REFERENCE TO FLOATING ROOF CONTAINMENT VESSELS)
Melvin W. First, Leslie Silverman, Daniel Fender, and Stanley Dawson Oct. 1965 65 p refs Revised
(Contract AT(30-1)-841)
(NYO-841-3, Rev.) CFSTI: HC $3.00/MF $0.75

Decontamination systems for rocket engine exhaust gases are discussed. Requirements for the gas cleaning systems are discussed. The technical features and economics of gas holding systems, on-stream gas cleaners, and confinement systems of underground tunnels are discussed.
NSA

N66-25124# Aktiebolaget Atomenergi, Stockholm (Sweden).
RADIATION EFFECTS ON SOLID, URANIUM BASED NUCLEAR FUEL MATERIALS, VOLUME 6, NUMBER 3 A Bibliography
W. Uhlmann Nov. 1965 56 p refs
(VODIT-16(5.3))

Fifty-four references are given to journals and reports published from 1963 through May 1965. The references are arranged under the headings: uranium metal; alloys; carbide; oxide; nitride; dispersion fuels; and coated particle fuels.
NSA

N66-25207# Argonne National Lab., Ill.
RIFF RAFF, A PROGRAM FOR COMPUTATION OF RESONANCE INTEGRALS IN A TWO-REGION CELL
P. H. Kier Aug. 1965 76 p refs
(Contract W-31-109-ENG-38)
(ANL-7033) CFSTI: HC $3.00/MF $0.75

A method of computing resonance absorption by a rod in a two-region cylindricalized cell that is not based on the assumption of an asymptotic neutron source distribution is developed and used to write a FORTRAN program RIFF RAFF (RP 359X), for the CDC-3600. An energy range of interest is divided into extremely narrow intervals of equal lethargy width. For each interval, the source distribution in each region is taken to be a three-term polynomial. By using this form for the source and the assumption that neutrons enter the rod isotropically, the reaction rates and the flux distribution for the interval are obtained. The reaction rates are accumulated over specified energy intervals to obtain resonance integrals; the flux distribution is used to obtain the source distribution for intervals at lower energies. RIFF RAFF allows for ten materials in each region. There can be four resonance absorbers in the rod, each having 60 resonances. The nonresonance materials can have 1/v absorption cross sections, with the restriction that for the moderator, the macroscopic absorption cross section must be small compared to the scattering cross section. The running time for a problem with 20 resonances and 4000 fine groups is about 2 min.
Author (NSA)

N66-25213# Sandia Corp., Albuquerque, N. Mex.
EVALUATION OF MICROSCOPIC-SIZED GRAPHITE AEROSOL FROM A ROVER REACTOR DESTRUCTION TEST, JUNE 1965
D. R. Parker Dec. 1965 24 p refs
(Contract AT(29-1)-789)
(SC-RR-65-557) CFSTI: HC $1.00/MF $0.50

The methods used to evaluate the environmental health aspects of particle dispersion and properties following the

destruction of a full-scale model of a ROVER-NERVA reactor are summarized. The methods used to collect airborne samples and to analyze the particles are described. Results on the total number and the size distribution of the particles are included. NSA

N66-25220# Los Alamos Scientific Lab., N. Mex.
SPECTRAL INDICES OF A 4.29% U^{235}-ENRICHED URANIUM METAL EXPONENTIAL COLUMN
R. G. Steinke 10 Jan. 1966 26 p refs
(Contract W-7405-ENG-36)
(LA-3406-MS) CFSTI: HC $2.00/MF $0.50

The spectral indices or detector ratios and buckling values characteristic of the equilibrium neutron energy spectrum in a 4.29% U^{235} enriched bulk of uranium metal were investigated. The 21-inch-diameter Los Alamos outdoor exponential column was utilized with the column and "Hydro" source reactor elevated some 11 feet above ground level.
Author (NSA)

N66-25222# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
XENON AND SAMARIUM TABLES
Barbara B. Occhipinti Jul. 1965 231 p refs
(Contract AT(07-2)-1)
(DP-958) CFSTI: HC $6.00/MF $1.25

Tables are presented for calculating the reactivity transients that result from ^{135}Xe or ^{149}Sm poisoning in any thermal reactor that employs ^{235}U as the principal fissionable material. Xenon and samarium concentrations are given as a function of time in units of absorptions per fission neutron. Tables are also given for the change in reactivity held in xenon after step reductions in power. Thermal flux is expressed in units of megawatts from thermal fissions per kilogram of ^{235}U. These tables cover a range of power from 0 to 500 Mw/kg. Author (NSA)

N66-25233# Pratt and Whitney Aircraft, Middletown, Conn.
SNAP-50/SPUR. COOLANTS AND WORKING FLUIDS Final Summary Report
Nov. 1965 103 p refs
(Contract AT(30-1)-2789)
(PWAC-481) CFSTI: HC $3.00/MF $0.75

The SNAP-50/SPUR power plant design was based on the use of lithium as a reactor coolant, potassium for the Rankine cycle working fluid, and eutectic NaK for the condenser coolant. The work accomplished in a comprehensive program to establish the necessary coolants and working fluid technology is summarized. Investigations were conducted in five areas of technology: analytical chemical techniques; methods were developed to analyze the alkali metals to determine trace metal, oxygen, nitrogen, and carbon contaminants to assure the efficacy of purification methods and to aid in evaluation of experiments; purification and handling techniques; procedures were established to provide for personnel and equipment safety and to assure that reproducibly high quality alkali metals were used to test systems; thermophysical properties; the thermophysical properties of the alkali metals were evaluated, and selected properties were measured to provide increase confidence in the design of engineering components; corrosion theory; investigations performed on columbium-zirconium alloys led to an understanding of the corrosion mechanism and thresholds of corrosion for refractory metals and alloys. These experiments resulted in establishment of specifications designed to eliminate failures by corrosive action of the alkali, and compatibility evaluations; laboratory and engineering tests showed that properly processed Cb-1 Zr alloy was compatible with the SNAP-50/SPUR alkali metal environments for extended periods at high temperatures. Encouraging results were obtained in limited compatibility tests of PWC-11 (Cb-1 Zr-0.01C) alloy with lithium and potassium, but definitive loop tests were not completed when the technical program was terminated. Author (NSA)

N66-25235# Pratt and Whitney Aircraft, Middletown, Conn.
USE OF HELIUM AND ARGON AS PROTECTIVE ENVIRONMENTS FOR SNAP-50/SPUR PROGRAM
E. A. Limoncelli Nov. 1965 91 p refs
(Contract AT(30-1)-2789)
(TIM-824) CFSTI: HC $3.00/MF $0.75

A technology of purified noble gas handling was developed. Application of the gas handling methods has provided helium and argon with concentrations of reactive contaminants lower than the sensitivities of available instrumentation. Data were obtained to permit the design of reliable, guaranteed life purifiers to provide low contaminant gas. Methods of assembling non-contaminating plumbing and control systems for gas transport were developed and used. Instrumental methods of analysis for oxygen, nitrogen, carbon containing gases, and water were evaluated and recommendations made for selection and use. Specifications necessary for implementation were prepared and are included. Author (NSA)

N66-25240# Battelle-Northwest, Richland, Wash.
METALLURGY RESEARCH SECTION QUARTERLY PROGRESS REPORT, JULY-SEPTEMBER 1965
15 Oct. 1965 91 p refs
(Contract AT(45-1)-1830)
(BNWL-166) CFSTI: HC $3.00/MF $0.75

Progress is reported in studies of physical metallurgy, reactor metals research, chemical metallurgy, and materials engineering. Considered in the physical metallurgy area are various plutonium investigations, radiation effects on metals, damage mechanisms, and examinations of swelling in irradiated fissionable materials. Reactor metals research includes in-reactor measurements of mechanical properties and weld zone fracture toughness determinations. Consideration is given to airborne test reactor gas loop support, production reactor corrosion and coatings studies, and N-reactor corrosion and hydriding studies relative to the chemical metallurgy area. Material engineering includes investigations with plutonium recycle test reactor pressure tubes, gas loop developments, and N-reactor studies. C.T.C.

N66-25242# General Electric Co., Cincinnati, Ohio. Atomic Products Div.
HIGH-TEMPERATURE MATERIALS PROGRAM Progress Report No. 54, Part A
20 Dec. 1965 86 p refs
(Contract AT(40-1)-2847)
(GEMP-54A) CFSTI: HC $3.00/MF $0.75

Work is summarized in specific in-process research and development efforts relating to high temperature materials. The effects of radiation on refractory metals and alloys are studied, and an evaluation is made of the plastic fatigue properties of heat resistant alloys. Radiation effects on heat resistant metals and alloys, and in BeO are also studied. Fission product transport processes in refractory metal fuel systems are examined and physico-chemical studies of clad UO_2 in potential meltdown environments are reported. Included are results of physico-chemical investigations of Fe-Cr-Al clad fuel systems. C.T.C.

N66-24415# Institut Franco-Allemand de Recherches, St. Louis (France).
PROPOSAL TO AMELIORATE THE RADIOACTIVE PREPARATIONS USED IN SPARK GAPS [VORSCHLAG ZUR VERBESSERUNG DER RADIUMRAPARATE IN DEN FUNKENSTRECKEN]
F. Daublin 5 Sep. 1963 38 p refs In GERMAN
(T-19/63) CFSTI: HC $2.00/MF $0.50

Examined was the radiation contamination of laboratory facilities utilizing radiating processes and sources. Wiping test on X-ray equipment and radiation source containers determined that radium containing preparations did not adhere to the required decontamination regulations. It was proposed to enclose all preparations with an 11μ thick airtight aluminum foil to prevent contamination of the facilities and the absorption of radioactive isotopes into the human system. Transl. by G.G.

N66-24443# Laboratorie De Physique Theorique et des Hautes Energies, Orsay (France).
REMARKS ON RELATIVISTIC STATISTICAL MECHANICS. II: DYNAMICS
Remi Hakim Mar. 1966 70 p refs
(TH-137) CFSTI: HC $3.00/MF $0.75

Dynamics are introduced for relativistic statistical mechanics: we mostly adopt the point of view developed by F. Rohrlich in a recent book. Consequently we define an extended phase space including acceleration variables and subsequent densities on it. Reduced densities for particles in interaction satisfy a hierarchy of equations derived with the help of the elegant method due to Klimontovich. The formalism is detailed on the example of the particle interacting with its self-field: the introduction of the acceleration variables avoids the use of the so-called field oscillators, while average radiation quantities are easily computed with the generalized density. In particular, a relativistic kinetic equation is derived (to the first order in $r_0=(2/3)(e^2/m)$=non causality time). The case of classical masic forces is also considered. The formalism, although completely general (it can easily be adapted to extended or spinning particles or to external gravitational forces) suffers the difficulties (both mathematical and physical) of all presently known non quantal relativistic dynamics of many-particle systems. Author

N66-24490*# Rocketdyne, Canoga Park, Calif.
PUMP DISCHARGE OSCILLATION STUDY Quarterly Progress Report No. 3, 1 Jan.-31 Mar. 1966
E Jackson 13 Apr. 1966 43 p refs
(Contract NAS8-20143)
(NASA-CR-74555; TAMM-6116-22) CFSTI: HC $2.00/MF $0.50 CSCL 20A

Acoustic waves transmitted by the flow leaving the impeller blades of an oscillation discharge pump were investigated. The impedance equations of curved elbows, orifices, and straight pipes were derived. A computer program was written for computing the unsteady blade loading due to the passage of viscous wakes. Some sample results obtained from the program are plotted; and the curves are compared to plotted results from Lefcort's theoretical calculations. In addition, the derivation of the conditions for wave reinforcement in pumps with a multi-vaned diffuser is presented. A test program for confirming these analytical results is planned for the Mark 28 fuel pump in the J-2 Air Rig. L.S.

N66-24577# National Physical Lab. of Israel, Jerusalem.
RESEARCH ON OPTICS OF SELECTIVE SURFACES. Final Report, 1 Jun. 1963-31 Oct. 1964
H. Tabor [1964] 74 p refs
(Contract AF 61(052)-659)
(AFCRL-65-625; AD-620508) CFSTI: HC $3.00/MF $0.75

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8. THE EVALUATION OF THE OPTICAL CONSTANTS OF A THIN INHOMOGENEOUS LAYER. II E. Wajsberg 5 p refs (See N66-24582 13-23)
9. OPTIMIZATION OF SURFACE PROPERTIES H. Weinberger 3 p

N66-24578# National Physical Lab. of Israel, Jerusalem.
ZERO-REFLECTION FROM THIN ABSORBING FILMS ON A METAL BASE
Hershel Weinberger *In its* Res. on Optics of Selective Surface [1964] 5 p refs (See N66-24577 13-23) CFSTI: HC $3.00/MF $0.75

The conditions for obtaining a zero reflectivity at a single given wavelength for the combination of a metal base and one or more transparent or absorbing coatings were previously worked out. It was shown that if the coatings are absorbing, there is a wide choice of optical properties in a two coating system that will give blooming. The original method showed the optical impedences of all bases that would be bloomed by a coating of given optical properties. This paper describes how this treatment can be inverted so that given the properties of the base, which may be a composite layer system, the numerical methods give the impedances of all layers which will bloom the base. R.N.A.

N66-24579# National Physical Lab. of Israel, Jerusalem.
SURFACES OF CONTROLLED SPECTRAL ABSORPTANCE
H. Tabor, Hershel Weinberger, and J. Harris *In its* Res. on Optics of Selective Surfaces 30 Sep. 1964 7 p refs Submitted for Publication (See N66-24577 13-23) CFSTI: HC $3.00/MF $0.75

Given the optical constants of absorbing materials to be applied as interference films on metal surfaces, it is possible to calculate the film thicknesses in two and three layer systems required to achieve high absorptance for solar radiation but low thermal emittance. The methods of making such calculations are reviewed and results for nickel-nickel black systems are presented and discussed. Author

N66-24580# National Physical Lab. of Israel, Jerusalem.
DESIGN OF BROAD-BAND HIGHLY ABSORBING SURFACES
Hershel Weinberger *In its* Res. on Optics of Selective Surfaces [1964] 8 p refs (See N66-24577 13-23) CFSTI: HC $3.00/MF $0.75

The usual procedure in designing highly absorbing surfaces is to match the optical constants of the substrate and coating films so as to achieve zero reflection at one or more wavelengths within the spectral region of interest. Having determined an appropriate base-film combination for blooming at chosen wavelengths, the system must, in general, be examined either numerically or experimentally for its wide band characteristics. In this paper, a method is developed for establishing a priori maximum limits of reflection from the film coated surface for a specified spectral range. Author

N66-24581# National Physical Lab. of Israel, Jerusalem.
DETERMINATION OF THE OPTICAL CONSTANTS OF CHEMICALLY DEPOSITED THIN FILMS OF METAL OXIDES
M. Kosower *In its* Res. on Optics of Selective Surfaces [1964] 18 p refs (See N66-24577 13-23) CFSTI: HC $3.00/MF $0.75

This report describes a method for determining the optical constants of chemically deposited thin films of metal oxides at their absorption edge from transmittance measurements for films of different thicknesses. The method is especially suited for regions of high dispersion and it is experimentally simple in that only transmittance and thickness measurements are required. An exact formula is presented for the logarithm of transmission as a function of thickness in which the linear and nonlinear terms are separated. This allows direct and rapid determination of both n and k from measured values and extends the method to regions of low absorptivity. Graphical methods are used to simplify the calculations involved. R.N.A.

N66-24582# National Physical Lab. of Israel, Jerusalem.
THE EVALUATION OF THE OPTICAL CONSTANTS OF A THIN INHOMOGENEOUS LAYER, II
E. Wajsberg *In its* Res. on Optics of Selective Surfaces [1964] 5 p refs (See N66-24577 13-23) CFSTI: HC $3.00/MF $0.75

Two equations were previously obtained which relate the optical constants of a thin layer and the complex reflection coefficients of the perpendicular and parallel components of the reflected light. This paper demonstrates how to avoid the experimental difficulties in measuring the absolute phase change of the reflected light beams by eliminating from the two equations the absolute phase differences to obtain a connection between the optical constants, the absolute magnitude of the reflection coefficients, and the relative phase difference between the two components of the reflected light. However, the amount of computation involved is considerably increased. R.N.A.

N66-24594*# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
AN ANALYSIS OF THE EFFECTS OF NON-ZERO BANDWIDTHS ON THE SECOND ORDER NONLINEAR OPTICAL INTERACTIONS
Joseph T. Mayhan 9 Nov. 1964 67 p refs *Its* Rept. 1093-24 (Grant NsG-74-60)
(NASA-CR-74620) CFSTI: HC $3.00/MF $0.75 CSCL 20F

This report analyzes the effects of small non-zero bandwidth on the second order optical interactions, with particular interest given to possible applications in the submillimeter wavelength. A classical, deterministic approach is taken throughout and Maxwell's equations govern all phenomena. Both mixing and parametric effects are considered, with quite general basic equations being derived. To present specific mixing results a gaussian frequency distribution is employed to crudely represent the laser radiation. The resulting equations for the mixing phenomena are complicated and must be integrated numerically. This results in the fact that the bandwidth has more predominant effects in generating the difference frequency rather that for the sum frequency. The model predicts no change in the phase matching conditions obtained with the monochromatic analysis. The phenomena of parametric amplification is considered, and a set of equations are derived which reduce to the proper results when mixing effects are considered. The equations are not solved, but are used to point out some possibly unexpected results. C.T.C.

N66-24703# American Meteorological Society, Boston, Mass.
SIX-j COEFFICIENTS WITH NEGATIVE PARAMETERS [6j-KOEFFITSIENTY S OTRITSATEL'NYMI PARAMETRAMI]
A. V. Karosene, A. Iu. Şavukinas, A. A. Bandzaitis, Is. I. Vizbaraite and A. P. Iutsis Bedford, Mass., AFCRL, Dec. 1965 16 p refs Transl. into ENGLISH from Litovsk. Fiz. Sb (USSR), v. 4, no. 2, 1964 p 187–198
(Contract AF 19(628)-3380)
(T-R-464; TT-66-60675; AD-628969) CFSTI: HC $1.00/MF $0.50

Five different possible forms of the formulas for the 6j coefficients are presented both in the form of unitary sums of expressions composed of factorials of linear combinations of parameters and in the form of quasi-binomials. These formulas are used to obtain the phase relations between 6j coefficients with negative parameters and the corresponding normal coefficients. The practical application of the proposed mathematics is illustrated through examples. Author (TAB)

N66-24724# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INTRODUCTION TO THE TECHNICAL THEORY OF STABILITY OF MOTION
K. A. Karacharov and A. G. Pilyutik 29 Dec. 1965 240 p refs Transl. into ENGLISH of the book "Vvedeniye v Tekhnicheskuyu Teoriyu Ustoychivosti Dvizheniya" Moscow, Gos. Izd. Fiz.-Mat. Lit., 1962 p 1–243
(FTD-MT-64-449; AD-629440) CFSTI: HC $23.60/MF $1.25

Criteria of stability are established with the help of the differential method both with and without using values of roots of characteristic equation. TAB

N66-24797# North Carolina Univ., Chapel Hill.
JOINT REPORT TO AIR FORCE OFFICE OF SCIENTIFIC RESEARCH AND OFFICE OF NAVAL RESEARCH Final Report, 1 Jan.–31 Dec. 1965
Bryce S. De Witt and H. Van Dam [1966] 15 p refs
(Contract Nonr-855(07); Grant AF-AFOSR-163-63)
(AD-628256) CFSTI: HC $1.00/MF $0.50

Summaries are given of work done in the following areas: Inner product in the canonical quantum theory of gravity; Theory of radiative corrections for non Abelian gauge fields; Radiation damping in a gravitational field; Classical relativistic

mechanics of interacting point particles; Asymptotic interaction angular momentum; Theorem of spinor-tensors; Conformal and projective Riemann spaces; Pedagogical method in relativity theory; Photon bound states and gravitons; Effect of terms quadratic in the Riemann tensor upon the field equations of general relativity; Proton-neutron mass difference; Spontaneous symmetry breakdown without massless bosons. TAB

N66-24878# European Organization for Nuclear Research, Geneva (Switzerland). Proton Synchrotron Machine Div.
MAGNETS WITH IRON YOKES AND FIELDS ABOVE 20 kG
K. Leeb and H. H. Umstatter 17 Feb. 1966 45 p refs
(CERN-66-7)

The magnetic field in conventional beam transport magnets is limited by the fact that iron saturates at 21.5 kGauss. This report proposes a method of using iron in magnets with uniform fields and fields with a constant gradient which are higher than this saturation level. These magnets can handle larger flux because the flux does not enter the aperture via restricted pole-faces but enters and leaves across the whole iron boundary. Apart from being a magnetic equipotential line the iron boundary is chosen as a line of constant flux density so as to allow the highest possible flux to pass through it. The coils cover the iron boundary and bend the field lines thereby increasing the flux density and producing the desired uniform or linearly varying field. The report also discusses the details of the field configuration in the corners of the aperture and presents numerical examples of 30 kGauss magnets taken from an earlier report. Author

N66-24894# Institut Franco-Allemand de Recherches, St. Louis (France).
METHOD OF DETERMINING THE RESISTANCE COEFFICIENT OF A SPHERE RELEASED AT GREAT VELOCITY IN A REENTRY SIMULATOR [METHODE DE DETERMINATION DU COEFFICIENT DE TRAINEE D'UNE SPHERE LANCEE A GRANDE VITESSE DANS LE SIMULATEUR DE RENTREE]
J. Luneau 13 Nov. 1964 44 p refs In FRENCH
(ISL-T-48/64) CFSTI: HC $2.00/MF $0.50

An approximation method is described for evaluating the coefficient of drag of a projectile at different points in its trajectory. It is said that the method is well suited for firings in a reentry simulator. The velocities and accelerations are calculated directly without taking into account either the change in the coefficient of drag along the trajectory or the density distribution in the blast pipe. The method gives results with precision on the order of 2 to 5%. Transl. by D.T.

N66-24941*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
STUDIES OF THE NEAR-FIELD NOISE PROPERTIES OF A SMALL AIR JET Final Report
David N. Keast and Gideon Maidanik Feb. 1966 103 p refs
(Rept.-1272
(Contract NAS1-4656)
(NASA-CR-74699) CFSTI: HC $4.00/MF $0.75 CSCL 20A

Experiments were conducted to determine whether certain properties of the sound field in the immediate vicinity of a supersonic jet are related directly to the properties of turbulent eddies within the jet. The acoustic radiation is studied, and consideration is given to the mechanism responsible for generating the radiation, and to the features of the radiation which indicate that near-field acoustic measurements can lead to information on the flow. Measurements were performed with a small supersonic air jet, and details are given on the experimental facility, and measurement configurations. The spectral and spatial-correlation properties of the noise field in the immediate vicinity of a small air jet were recorded and analyzed over the frequency range from 1000 cps to 60,000 cps. The experimental data are assessed, and the results are theoretically interpreted. It was concluded that the observed near-field noise properties of the air jet apparently have a qualitative relationship to the properties of turbulent eddies convected supersonically within the jet, and that this relationship seems to hold for the mean convection velocity of the eddies, and for the mean eddy size. M.G.J.

N66-25019*# Astro Research Corp., Santa Barbara, Calif.
ELECTROMAGNETIC FORCES ON SPACE STRUCTURES
W. M. Robbins, Jr. Washington. NASA. May 1966 38 p refs
(Contract NASw-652)
(NASA-CR-476) CFSTI: HC $2.00/MF $0.50 CSCL 20C

The tensile and axial forces and the moments acting upon a conducting loop are examined for the cases that the loop is (a) completely isolated, (b) in the presence of another coaxial conducting loop, (c) in a uniform magnetic field, and (d) in a nonuniform magnetic field. The results are presented so that the relative magnitudes of the effects and the numerical values can be evaluated for specific examples. Two such examples are worked out, one being the case of a loop in the earth's magnetic field and maintained circular by passing a current through the loop. The other example is that of reorienting the axis of symmetry of a very large paraboloidal antenna in the earth's magnetic field by generating loop currents in the antenna. The forces caused by an electrostatic charge placed on (a) a long wire, (b) a circular disk, and (c) a sphere, are examined. High tensile stresses are caused in a thin wire by a few hundred kilovolts but the same voltage causes only relatively very low stresses in the other two cases. Author

N66-25029# Minnesota Univ., Minneapolis. Particle Technology Lab.
THE ELECTRICAL CHARGING OF SMALL PARTICLES AT LOW PRESSURES Third Progress Report, 15 Sep. 1964-15 Sep. 1965
B. Y. H. Liu Oct. 1965 80 p refs
(Contract AT(11-1)-1248)
(COO-1248-4) CFSTI: HC $3.00/MF $0.75

The electric charge imparted to aerosol particles ranging in size from 0.08μ to approximately 3μ was measured experimentally in a combined charger and mobility analyzer over the pressure range from 0.01 to 0.001 atmosphere. Solid spherical particles of methylene blue dye were used in these studies and they were charged under electric field intensities of 100 and 240 volts/cm by positive ions produced in a corona discharge. The product of ion concentration and charging time used in the experiments ranged to a maximum value of 3.0×10^6 (ions/cc)(sec). The measured charge on particles was compared with values predicted by various theories and the results indicate that both the diffusion and field charging equations underestimate the particle charge by a factor ranging from approximately 2 to 30. NSA

N66-25030# Osterreichische Studiengesellschaft fur Atomenergie G.m.b.H., Seibersdorf (Austria).
FOCUSING CHARACTERISTICS OF ELECTRIC FIELDS [FOKUSSIERUNGSEIGENSCHAFTEN ELEKTRISCHER FELDER]

M. J. Higatsberger [1965] 19 p refs In GERMAN Presented at Austrian Phys. Soc. Conf., Vienna, Oct. 1965 Submitted for Publication
(SGAE-G-3/1965)

A review is given of the focusing properties of electric fields using the examples of lens for pure electron optics and for lenses combined with magnetic fields in mass spectroscopy. The use of focusing electric fields in quadrupole or multipole fields, in ion drives in rocket systems, and in variants of particle accelerators are also considered in order to indicate the need for extensive research in these fields. NSA

N66-25090# California Univ., Livermore. Lawrence Radiation Lab.
A COVARIANT FORM OF CONTINUUM MECHANICS AND THERMODYNAMICS
M. Neuman 25 Aug. 1965 36 p refs
(Contract W-7405-ENG-48)
(UCRL-14399) CFSTI: HC $2.00/MF $0.50

Continuum mechanics and thermodynamics are presented in a form independent of coordinate frames and their condition of motion. With respect to the absence of reference to inertial frames the representation resembles that of Maxwell's equations for the electromagnetic and Einstein's for the gravitational field rather than the usual mechanical theories. The basic dynamical variables are the metric tensor, the differential circulation (rather than momentum), and entropy. From this general form the usual Euler, Lagrange, and noninertial laboratory representations may be obtained through specialization. Author (NSA)

N66-25117# Stanford Research Inst., Menlo Park, Calif. Dept. of Surface Physics and Chemistry.
SORPTION OF GASES ON METAL SURFACES IN ULTRA-HIGH VACUUM Quarterly Progress Report No. 12, 15 Aug.–15 Nov. 1965
B. Bergsnov-Hansen, N. Endow, B. Evans, and R. A. Pasternak 26 Nov. 1965 9 p
(Contract AT(04-3)-425)
(SRIA-425-7) CFSTI: HC $1.00/MF $0.50

Progress in studies on the adsorption of D by evaporated Mo films and the solution of N_2 in Nb is reported. NSA

N66-25130# Joint Inst. for Nuclear Research, Dubna (USSR). Lab for Theoretical Physics.
ON PROPAGATION OF HIGH FREQUENCY SIGNALS IN MEDIUM WITH RANDOM CHARACTERISTICS [O RASPROSTRANENII SIGNALOV VYSOKOI CHASTOTY V SREDE SO SLUCHAINYMI KHARAKHTERISTIKAMI]
D. I. Blokhintsev 15 Oct. 1965 10 p *refs* In RUSSIAN
(JINR-P-3295)

Solutions of the second order linear equation with random coefficients for high frequency signal (the geometric optics approximation) are treated. Author (NSA)

N66-25209# California Univ., Berkeley. Lawrence Radiation Lab.
ISO—A FORTRAN PROGRAM FOR UTILIZING THE STRONG-FOCUSING PRINCIPLE IN BETA-RAY SPECTROMETER DESIGN
Herman Owens 21 Oct. 1965 16 p *refs*
(Contract W-7405-ENG-48)
(UCRL-16471) CFSTI: HC $1.00/MF $0.50

An IBM FORTRAN II code to calculate beta-ray spectrometer characteristics of aberration, dispersion, transmission, and resolution, using azimuthally varying magnetic fields, is described. Author (NSA)

N66-25303# National Bureau of Standards, Washington, D. C.
SOUND INSULATION OF WALL, FLOOR, AND DOOR CONSTRUCTIONS
Raymond D. Berendt and George E. Winzer 30 Nov. 1964 59 p refs Supersedes BMS-144, Suppl. 1 and 2
(NBS-Monograph-77; BMS-144, Suppl. 1; BMS-144, Suppl. 2) GPO: $0.40

This report summarizes data on the sound insulating properties of building materials for wall, floor, and door constructions. Single figure ratings, sound transmission class and impact noise ratings for airborne sound transmission and impact sound transmission, respectively, as well as the octave frequency band spectra of impact noise are given as additional information. A brief description of the sound measuring techniques is included. R.N.A.

N66-25382# New York Univ., N. Y. Courant Inst. of Mathematical Sciences.
ENERGY IDENTITIES FOR THE WAVE EQUATION
Cathleen S. Morawetz Jan. 1966 28 p refs
(Contract DA-31-124-ARO-D-365)
(AROD-5682-1; IMM-346; AD-630506) CFSTI: HC $2.00/MF $0.50

These identities will be rederived for three space variables by noting that certain transformations, in particular the Kelvin transformation, leave the wave operator invariant and, hence, the classical energy identity can be transformed into other identities. The Kelvin transformation and the resulting identity are applied to incoming and outgoing waves. The main theorem of the first part is used to prove the following result in geometrical optics: Suppose that we are given a smooth, star-shaped perfectly reflecting, three-dimensional body that extends to infinity and that a high frequency harmonic source of light illuminates the region outside the body in such a way that no shadow is cast. The field is given by a solution of a boundary value problem for the reduced wave equation. There is also an approximate solution given by geometrical optics. The theorem states that these two are asymptotically equal in the limit of infinite frequency for the harmonic source. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N66-23945# Oslo Univ., Blindern (Norway). Inst. for Theoretical Physics.
ELECTRONIC STRUCTURE AND ENERGY LEVELS OF MANY ELECTRON ATOMS Final Scientific Report

John Midtdal 25 Jan. 1966 8 p
(Grant AF-EOAR-64-32)
(AFOSR-66-0362; AD-628922) CFSTI: HC $1.10/MF $0.50

The document is comprised of abstracts of results (published elsewhere) of work in the following areas: theoretical and numerical investigations of two-electron atoms and ions, with perturbation theory expansions of their energies and wave functions; theoretical investigations of the rotational energy of the asymmetrical top; quantum particle dynamics and scattering problems in quantum mechanics.
Author (TAB)

N66-23972# Pennsylvania Univ., Philadelphia. Dept. of Physics.
WICK AND GOLDSTONE THEOREMS FOR GENERAL SPIN. ANTIFERROMAGNETIC SPIN WAVES II
Yung-Li Wang and H. B. Callen Jan. 1966 30 p refs
(Contract Nonr-551(36))
(TR-29; AD-629141) CFSTI: HC $2.60/MF $0.50

The analogues of Wick's theorem and of Goldstone's theorem, proved in the preceding paper (AD-624 720) for spin 1/2, are generalized to arbitrary spin. The proof is based on the Schwinger coupled-boson representation of spin operators. Quantum corrections to the spin wave modes in antiferromagnets are again considered, and it is shown that these corrections can be expanded in powers of 1/2Sz, where z is the number of nearest neighbors. For large S the 1/S factor presumably provides convergence, as assumed by Oguchi, whereas for S=1/2 the expansion parameter reduces to 1/z, as discussed in the preceding paper. Author (TAB)

N66-23983# Uppsala Univ. (Sweden). Quantum Chemistry Group.
THE GROUND-STATE THREE-BODY CORRELATION FUNCTION IN A DILUTE BOSON GAS WITH HARD-SPHERE INTERACTION Scientific Report No. 41
Vedene H. Smith, Jr. 15 Apr. 1965 11 p refs *Its* Preprint No. 147
(Contract AF 61(052)-701)
(ARL-66-0034; AD-629091) CFSTI: HC $1.60/MF $0.50

The three-body correlation function for the ground state of a boson gas with hard sphere interactions is evaluated in the approximation of pair excitations. The evaluation is made using both the formalism of second quantization and the cluster expansion method in configuration space. The result is compared with a previous calculation using the same wave function. The behavior of the correlation function is discussed.
Author

N66-24107*# Geophysics Corp. of America, Bedford, Mass.
SPUTTERING ION SOURCE STUDY PROGRAM Final Report, 29 Jan.-15 Nov. 1962
15 Dec. 1962 31 p
(Contract JPL-950118)
(NASA-CR-71924; GCA-TR-62-10-G) CFSTI: HC $2.00/MF $0.50 CSCL 20H

A description of the operation of a duoplasmatron which may be used as a sputtering ion source for the analysis of solids is provided. A simple is bombarded with an intense beam of fast noble gas ions, which should result in sputtering of the sample material. The ions can be accelerated and analyzed in a mass spectrometer. One feature of this ion source is that the gaseous background from hydrocarbons and the constituents of the air seem to be small compared to the intensities of the sputtered ions. The mass spectra obtained are reported to be extremely simple and consist essentially only of peaks from single ionized atoms. Another feature of this ion source as compared to the conventional spark source is its stable operation, thereby permitting electrometric recording of the mass spectrum. A discussion of the sputtering phenomena is included and some examples of spectra obtained are shown. H.S.W.

N66-24206# Oak Ridge National Lab., Tenn. Isotopes Information Center.
PROCEEDINGS OF SYMPOSIUM ON LOW-ENERGY X-RAY SOURCES AND GAMMA SOURCES AND APPLICATIONS
Philip S. Baker and Martha Gerrard ed. Nov. 1965 405 p refs Symp. Held at IIT Res. Inst., Chicago, 20-21 Oct. 1964
(Contract W-7405-ENG-26)
(ORNL-IIC-5; CONF-64-1017) CFSTI: HC $4.00/MF $1.75

Developments in low energy X- and gamma-ray sources are reviewed, and several techniques are discussed in detail. These include both machine and isotopic sources, and detection and imaging of the radiations. The applications of isotopes and radiation technology to science, engineering, medical, industrial, and related needs are emphasized throughout the presentations. For individual titles see N66-24207-N66-24230.

N66-24207# IIT Research Inst., Chicago, Ill.
STUDY, DESIGN, AND APPLICATIONS OF BETA-EXCITED X-RAY SOURCES
J. J. Ezop and T. G. Stinchcomb *In* ORNL Proc. of Symp. on Low-energy X-ray Sources and Gamma Sources and Appl. Nov. 1965 p 4-37 refs (See N66-24206 13-24) CFSTI: HC $4.00/MF $1.75

A review is presented of the results of several studies on the characteristics (yield and spectral distribution), designs, and uses of beta excited X-ray sources. These include an analytical study of X-ray production (both bremsstrahlung and characteristic X-rays) in several source target configurations and a comparison with the results of experimental investigations using ^{147}Pm, ^{85}Kr, and ^{90}Sr (^{90}Y) sources with tin and lead target materials. The good agreement between calculated and experimental data makes possible the optimization of the design of beta excited X-ray sources to meet the requirements of specific applications. The design, yield and spectral distribution of prototype sources are discussed, along with their performance in practical applications of thickness gaging, fluorescent excitation, critical absorptiometry, and radiography. Author (NSA)

N66-24208# Oak Ridge National Lab., Tenn.
RECENT DEVELOPMENTS IN PRODUCTION OF LOW-ENERGY GAMMA-RAY AND X-RAY EMITTERS
F. N. Case and R. S. Pressly *In its* Proc. of Symp. on Low-Energy X-ray Sources and Gamma Sources and Appl. Nov. 1965 p 39-50 refs (See N66-24206 13-24) CFSTI: HC $4.00/MF $1.75

The design of radioactive sources as directed toward obtaining maximum output of low energy gamma and Bremsstrahlung radiation is described. The methods of fabrication, encapsulation, and the measurement of the energy of the radiation from the sources are discussed. A summary is given of the new radioisotopes which are presently being investigated and their availability. Author (NSA)

N66-24209# Henry Ford Hospital, Detroit, Mich. Edsel B. Ford Inst. for Medical Research.
X-RAY ABSORPTIOMETRY WITH BETA-STIMULATED X-RAY SOURCES AND PROGRESS REPORT ON COMPILATION OF BETA-EXCITED SPECTRA
Luther E. Preuss, H. Collins, and J. Kann *In* ORNL Proc. of Symp. on Low-energy X-ray Sources and Gamma Sources and Appl. Nov. 1965 p 51–71 refs (See N66-24206 13-24) CFSTI: HC $4.00/MF $1.75

Characteristic X-radiation and bremsstrahlung photons, produced by ^{147}Pm betas in copper, iron, and molybdenum targets, were studied for their application in absorptiometry. A device designed specifically for the absorptiometry with beta excited sources was used. Spectral hardening proved to be a prevalent phenomenon with some of these sources. Properly designed beta stimulated sources showed promise. Progress in the compilation of a comprehensive series of beta excited spectra is also reported. Author (NSA)

N66-24210# Industrial Nucleonics Corp., Columbus, Ohio.
ANALYSIS AND MEASUREMENT OF MATERIALS WITH LOW-ENERGY RADIATION
Charles O. Badgett *In* ORNL Proc. of Smyp. on Low-Energy X-ray Sources and Gamma Sources and Appl. Nov. 1965 p 72–90 refs (See N66-24206 13-24) CFSTI: HC $4.00/MF $1.75

It is shown that soft X-ray or gamma photons may be used for measurement of properties of materials. Both physical and chemical properties may be expressed in terms of energy and/or absorption values. Examples of the use of such ideas in simple stream analysis are presented for illustration. Use of low energy photons permit reasonably small amounts of shielding and the manufacture of high strength (intense) radiation sources having selected wavelengths of emission. This selective radiation can in turn be used to measure several different material properties. Author (NSA)

N66-24211# Hittman Associates, Inc., Baltimore, Md. Isotopic Power Section.
BREMSSTRAHLUNG FROM ^{90}SR-Y IN THIN ABSORBERS
Thomas S. Bustard and Joseph Silverman (Maryland Univ.) *In* ORNL Proc. of Symp. on Low-Energy X-ray Sources and Gamma Sources and Appl. Nov. 1965 p 91–98 refs (See N66-24206 13-24) CFSTI: HC $4.00/MF $1.75

The bremsstrahlung yields from targets ranging in atomic number from 13 to 73 with a thin, point source of ^{90}Sr–^{90}Y are presented. A novel method of obtaining these yields was used, the bremsstrahlung spectra being measured as they are built up and attenuated through targets whose mass thicknesses are less than the range of the ^{90}Y maximum energy beta particle. The resulting bremsstrahlung yields were then compared to those calculable from the Evans (Evans, R. D., The Atomic Nucleus, 1955) approximation to thick target theory. Author (NSA)

N66-24212# Martin Co., Baltimore, Md. Nuclear Div.
EXTERNAL BREMSSTRAHLUNG PRODUCED IN THIN FOILS BY ^{147}PM
Vincent C. Truscello and Joseph Silverman (Maryland Univ.) *In* ORNL Proc. of Symp. on Low-Energy X-ray Sources and Gamma Sources and Appl. Nov. 1965 p 99–106 refs (See N66-24206 13-24) CFSTI: HC $4.00/MF $1.75

A NaI(Tl) scintillation spectrometer was used in conjunction with a 512-channel analyzer to study the spectral distribution of the external bremsstrahlung produced by ^{147}Pm betas (E_{max}=223 keV) in thin foil targets ranging in thickness from 1 to 70 mg/cm^2 and in atomic number from 13 to 73. The bremsstrahlung was found to have a linear dependence on the atomic number of the target material as predicted by theory. Empirical relations among the experimental data were determined. Author (NSA)

N66-24217# International Atomic Energy Agency, Vienna (Austria).
RADIOISOTOPE SOURCES OF LOW-ENERGY ELECTROMAGNETIC RADIATION AND THEIR USE IN ANALYSIS AND MEASUREMENT OF COATING THICKNESS
J. F. Cameron and T. Florkowski *In* ORNL Proc. of Symp. on Low-Energy X-ray Sources and Gamma Sources and Appl. Nov. 1965 p 182–205 refs (See N66-24206 13-24) CFSTI: HC $4.00/MF $1.75

Recent developments in the application of radioisotope sources of low energy electromagnetic radiation outside the USA are reviewed. Such sources have advantages over electrical X-ray generators, viz., their small physical size, comparatively low cost, stability of output in terms of energy and time, and independence of power supplies. They are being increasingly applied in industry, particularly for analysis, the techniques of which are discussed in some detail. The use in measuring coating thickness is discussed only briefly. Author (NSA)

N66-24229# American Machine and Foundry Co., Alexandria, Va.
PROTON-EXCITED X-RAYS AND APPLICATIONS
Andrew A. Stark *In* ORNL Proc. of Symp. on Low-energy X-ray Sources and Gamma Sources and Appl. Nov. 1965 p 339–352 refs (See N66-24206 13-24) CFSTI: HC $4.00/MF $1.75

Some of the characteristics of X-ray generation by proton bombardment are described. With work still in progress, it has been proven that this method is particularly suitable for soft X-rays >10 Å. Excitation efficiencies are equal to or better than with electron excitation, while the resulting spectrum consists of a single characteristic radiation line, but with complete absence of bremsstrahlung. Experimental results, the design of an instrument, and some applications are discussed. Author (NSA)

N66-24230# Parametrics, Inc., Waltham, Mass.
GENERATION AND PRACTICAL USE OF MONOENERGETIC X-RAYS FROM ALPHA-EMITTING ISOTOPES
Bach Sellers and C. A. Ziegler *In* ORNL Proc. of Symp. on Low-energy X-ray Sources and Gamma Sources and Appl. Nov. 1965 p 353–373 refs (See N66-24206 13-24) CFSTI: HC $4.00/MF $1.75

The various methods of generating X-radiation by ejection of orbital electrons through the interaction of radio-active particles and gamma rays with materials are summarized. Excitation by beta particles produces, in addition to monoenergetic characteristic radiation, a large quantity of continuous bremsstrahlung. In many situations this bremsstrahlung is an undesirable background and must be removed. The use of alpha particles to excite characteristic radiation alleviates this problem, since the bremsstrahlung produced by such massive particles is not of practical concern. Therefore, with alpha-emitting isotopes, it is possible to make essentially monoenergetic X-ray sources that would have important application in areas such as composition analysis, density and thickness measurement, and absorption edge microradiography. Theoretical and experimental results on

the X-ray yield of such sources are presented and these yields are shown to be consistent with those observed by others using proton excitation. Author (NSA)

N66-24310# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
DETERMINATION OF THE BRANCHING RATIOS AMONG THE NEUTRAL DECAY MODES OF THE eta-PARTICLE
G. Di Giugno, M. Giorgi, R. Querzoli, P. Schiavon, V. Silvestrini et al 1 Mar. 1966 11 p refs
(LNF-66/9) CFSTI: HC $1.00/MF $0.50

A 1.2 GeV/c momentum negative pion beam from a proton synchrotron, incident upon a 20 cm long hydrogen target, where the reaction

$$\pi^- + p \rightarrow \eta + n$$

is produced, was used to determine the branching ratios among the neutral decay modes of the eta meson. Strong evidence for the presence of the mode $\eta \rightarrow \pi^0 \gamma\gamma$ was obtained. The results are:

$$R_1 = \frac{\eta \rightarrow \gamma\gamma}{\eta \rightarrow \text{all neutrals}} = (41.6 \pm 2.2)\%;$$

$$R_2 = \frac{\eta \rightarrow 3\pi^0}{\eta \rightarrow \text{all neutrals}} = (20.9 \pm 2.7)\%; \text{ and}$$

$$R_3 = \frac{\eta \rightarrow \pi^0\gamma\gamma}{\eta \rightarrow \text{all neutrals}} = (37.5 \pm 3.6)\%.$$

From these ratios it was calculated that

$$R = \frac{\eta \rightarrow \gamma\gamma}{\eta \rightarrow (3\pi^0 + \pi^0\gamma\gamma)} = 0.7 \pm 0.07.$$

It is pointed out that this value is in good agreement with the Frascati result of R = 0.80 ±0.25. The experimental arrangement and method are described in detail. D.T.

N66-24324# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
KINEMATICS OF THE (e,e'p) REACTION [CINEMATICA DELLA REAZIONE (e,e'p)]
D. Giucci 23 Dec. 1965 110 p In ITALIAN; ENGLISH summary
(ISS-65/49) CFSTI: HC $4.00/MF $0.75

The kinematics of electron–nucleon collisions in a nucleus is described; and a Fortran IV program is presented for the calculation of the kinematics. Some kinematic tables showing the response of protons to electrons in a nucleus are given. D.T.

N66-24360# California Univ., La Jolla.
CONTINUITY BETWEEN BOUND AND UNBOUND STATES IN A FERMI GAS
W. Kohn and C. Majumdar 3 Feb. 1965 20 p refs
(Contract Nonr-2216(11))
(TR-28; AD-613343) CFSTI: HC $1.00/MF $0.50

A soluble model of a gas of independent Fermions in the presence of an attractive localized potential is considered. It is shown that the properties of the system as a whole are smooth (analytic) functions of lambda, even at those values of lambda where new single particle bound states appear. Thus for the system as a whole, the transition from screening to binding is smooth and the concept of a bound state cannot be given a sharp meaning. Implications for certain metals and alloys are discussed. Author (TAB)

N66-24362# Illinois Univ., Urbana. Dept. of Physics.
RESEARCH IN NUCLEAR PHYSICS Annual Summary Report, Period Ending Dec. 1, 1965
G. M. Almy [1965] 107 p refs
(Contract Nonr-1834(05))
(AD-625210) CFSTI: HC $4.00/MF $0.75

Contents: Polarization in the Elastic Scattering of Protons From Carbon and Nitrogen; Scattering of Low Energy K^--Mesons by Nuclei; Peripheral Production and Decay; Correlations of Resonances; Peripheral Production and Decay of Resonances in High-Energy Meson–Nucleon Collisions; Evidence for Triangle Singularities; Interpretation of the ϵ in K^+p to K $3\pi p$; Integral Equation for the Anomalous Deuteron Vertex and a Comparison of two Normalization conditions; Bound States in a system of two Vector Mesons; Recoilless Fractions from Mossbauer Scattering; Mossbauer Effect at High Pressure for Fe^{57} in Titanium, Vanadium, and Copper; Outer-Shell Overlap integrals as a Function of Distance for Halogen–Halogen, Halogen–Alkali, and Alkali–Alkali Ions in the Alkali Halide Lattices; Mossbauer Evidence for Highly Charged States following Co^{57} Electron Capture in Hydrated Cobalt Compounds; Mossbauer Effect of FE^{57} on the Surface of Tungsten; Mossbauer Scattering Studies with Os^{186}, Os^{188}, Eu^{153} and Pr^{141}; Cross Sections for the S^{32} (γ, np) P^{30}, Ca^{40} (γ, np) K^{39}, and Zn^{68}(γ, np) Cu^{64}. Reactions from 50 to 300 MeV; Cross Sections for 16_O(γ, π)N^{16}; Cross Sections for ^{51}V(γ, π⁻2n)Cr^{49}; Neutron Spectra from Monoenergetic Photons on Bismuth; Reaction He^3(γ,π⁺)H^3 up to 260 MeV. TAB

N66-24418# Palermo Univ. (Italy).
RESEARCH ON NUCLEAR PHYSICS [RICERCHE SULLA FISICA DEI NUCLEI]
Brussels, Euratom, 1966 98 p refs In ITALIAN; ENGLISH summary
(EUR-2485.i) CFSTI: HC $3.00/MF $0.75

A general account is given of the work carried out from 1961 to 1963 under the three-year research contract No. 001-60-12 MPAI concluded between Euratom and the CNEN for the study of low-energy nuclear phenomena and the interaction of ionizing radiations and photons with matter. This concise work contains details of the organization and administration of the contract, and an indication of the general lines along which the scientific programme was carried out, with particular reference to the most important results obtained. Finally, it includes the more detailed reports describing the research carried out by the individual teams, followed by a general list of references and some appendices giving details of a technical and organizational nature. Author

N66-24654# North Carolina Univ., Chapel Hill.
INTERACTIONS OF THE GRAVITATIONAL FIELD WITH A GENERALIZED YANG-MILLS FIELD
Allen Clark Dotson (Ph.D. Thesis) 1964 66 p refs

Quantum field theory is applied to the interaction between gravitational and generalized Yang–Mills fields. The dynamics are based on the principle of least action. The generalized Yang–Mills group is combined with the invariance group of general relativity, and the theory is required to be invariant under the combination. The derivation of the S-matrix amplitudes in the linearized version of the general theory is

discussed. The results are applied to (1) Yang–Mills field self-scattering by way of an intermediate graviton, (2) single-graviton production, (3) double-graviton production, and (4) Compton-type scattering of Yang-Mills quanta by gravitons. In each process, the magnitude by which the total spin can change during the interaction is found to be restricted to the minimum possibility—zero for processes (1), (3), and (4), and unity for case (2). The scattering cross sections in the center-of-momentum system are computed. A discussion is given of the infinite renormalization terms which must be added to the classical action to keep the quantum theory meaningful when the contributions of higher-order interactions are included. Approximate expressions for the Feynman Green's functions for the combined fields and for the combined invariance group are calculated. These results lead to the terms needed to renormalize the action. Author (NSA)

N66-24674# Smithsonian Astrophysical Observatory, Cambridge, Mass.
KERNEL REPRESENTATIONS IN THE SOLUTION OF LINE-TRANSFER PROBLEMS
E. H. Avrett and R. Loeser 18 Feb. 1966 127 p refs
(SAO Special Rept.-201)

We describe in detail a method of solution for a certain class of line-transfer problems. We also discuss the physical characteristics of this given type of problem, and show how the equations for particular cases are derived. The basic numerical method involves the solution of integral equations having the form

$$S(\tau) = [1 - \epsilon(\tau)] \int_0^T K(|t - \tau|)\, S(t)\, dt + \epsilon(\tau)\, B(\tau).$$

We deal only with those cases for which the kernel function has the form $K(|t - \tau|)$, a restriction that involves several physical approximations. Despite this restriction, the method is applicable to a great many problems of physical interest; especially to the transfer of line radiation by atoms with many levels. Author

N66-24701# California Univ., Los Angeles. Dept. of Physics.
INELASTIC SCATTERING AT 45.5 MeV PROTONS FROM BERYLLIUM AND CARBON
Edward Petersen Jan. 1966 76 p refs
(Contract Nonr-233(44))
(P-74; AD-628932) CFSTI: HC $7.60/MF $0.75

The differential cross sections for the excitation of nine levels of carbon and one level of beryllium are reported for 35 angles from 15 to 150 degrees. The results for the 2.43 MeV level of beryllium and the 4.4 and 9.6 MeV levels of carbon have an average relative accuracy of 3% while the 7.6 10.8, 11.8, 12.7, 14.0, 15.1, and 16.1 MeV levels of carbon have an average accuracy of 10%. The cross sections change by one to three orders of magnitude from forward to backward angles. Levels at 13.3 and 16.6 MeV in carbon were not observed. The experimental apparatus is described, and the 2.43, 4.4, 7.6, and 9.1 Mev angular distributions are compared with distorted wave calculations. Author (TAB)

N66-24719# Naval Radiological Defense Lab., San Francisco, Calif.
GAMMA-RAY ENERGY PSEUDOSPECTRA FOR U235 FISSION PRODUCTS AND FOR VARIOUS TIMES AFTER FISSION
Charles F. Ksanda, Endel Laumets, and Michael A. Hogan 18 Dec. 1965 99 p refs
(USNRDL-TR-942; AD-628982) CFSTI: HC $3.00/MF $0.75

The gamma-ray energy spectrum of U-235 fission products following a nuclear explosion is made up of hundreds of different photon energies whose relative contributions to the spectrum change with time after fission. Gamma radiation attenuation and shielding calculations can be greatly simplified by the use of 'pseudospectra' that closely approximate the attenuation obtained with the 'true' spectra. A technique for computing pseudospectra weighting fractions to obtain such simplified spectra composed of only 5 representative photon energies is described. Pseudospectra weighting fractions and pseudospectra for air and iron attenuation are presented. A flow chart and an IBM-704 computer program of the technique are also presented, along with the input data and examples of the printed output values. Throughout the time range considered (from 1.7 sec to 301 days after fission), the maximum attenuation error is less than ±5%. The technique is valid for resolving almost any spectral attenuation data into five or fewer energy components, and may be used to solve problems involving five simultaneous equations in five unknowns with prescribed constraints. Author (TAB)

N66-24757# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
DISSOCIATIVE ATTACHMENT IN REARRANGEMENT ELECTRON COLLISION WITH MOLECULES
Joseph C. Y. Chen 30 Dec. 1965 43 p refs
(JILA-60)

The expansion method proposed for treating dissociative attachment in rearrangement electron collision with molecules is examined. It is shown that this method is useful only when the recoils in the rearranged channels can be neglected and when the intermediate negative ion states are stationary states. The latter limitation prevents the method from giving an adequate description of resonance dissociative attachment, since in this case the intermediate states are compound states with decaying widths. To account for these difficulties an alternative method is proposed. In this method, a projection operator is derived which is capable of decoupling the elastic channel and all the rearranged open channels from the rest of the Hilbert space. This then leads to an exact description of the process by a finite set of coupled equations. Specialization of this method to account for resonance dissociative attachment is also carried out. It is then shown how the observed isotope effect for dissociative attachment in the electron–hydrogen system can be understood in terms of the present theory. L.S.

N66-24791# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.
HIGH ENERGY PHYSICS RESEARCH USING A 460 MeV SYNCHROCYCLOTRON Final Report
Herbert L. Anderson 14 Jul. 1965 15 p refs
(Contract N6Ori-020)
(AD-618067) CFSTI: HC $1.00/MF $0.50

Doctoral dissertations are listed for students who conducted their research with the cyclotron. Also given is a chronological list of published research. TAB

N66-24800# Northeastern Univ., Boston, Mass.
RESEARCH ON ELEMENTARY PARTICLES AND RELATIVITY THEORY
Richard Arnowitt Wright-Patterson AFB, Ohio, ARL, Dec. 1965 158 p refs
(Contract AF 33(657)-10161)
(ARL-65-254; AD-629763) CFSTI: HC $5.00/MF $1.00

The work described involves a number of topics in classical and quantum relativity theory including the following: (1) Examination of asymptotic properties of general relativity in the space-like asymptotic region. (2) Critique of the Holye-Narlikar theory. (3) Analysis of q-number coordinate transformations. (4) Study of a quantized spinor field in an external gravitational field. (5) Study of the role of rigid bodies in relativity. (6) Analysis of scattering of a gravitational wave off a mass point. Author (TAB)

N66-24864# Princeton Univ., N. J. Elementary Particles Lab.
A SEARCH FOR ANTIPROTONS AND STUDY OF PARTICLE PRODUCTION IN 3-BeV PROTON-NUCLEUS COLLISIONS Technical Report, Oct. 1963-Jan. 1966
A. J. Stewart Smith (Ph.D. Thesis) 24 Jan. 1966 147 p refs
(Contract Nonr-1858(06))
(TR-40; AD-478178)

In two counter experiments at the Princeton-Pennsylvania Accelerator, a study has been made of 2.9 BeV proton-nucleus collisions. In the first experiment differential cross sections were measured as a function of momentum for the production of Pi mesons, K^+ mesons, protons, deuterons, tritons, and helium-3 by 2.9 BeV protons striking beryllium and platinum targets. The Be data were taken at laboratory angles of 13, 30, 60, and 93 degrees relative to the direction of the incident proton beam; the Pt data, at 13 degrees and 93 degrees only. An analysis of these cross sections is given in terms of models of proton-nucleus interactions. The copious production of deuterons and tritons at all angles is found to be a complex nuclear effect. In a second experiment, antiproton production was observed in 2.88 BeV and 2.05 BeV proton-copper collisions, at a laboratory angle of 13 degrees and at a momentum of 760 MeV/c. The cross section for this antiproton production is presented, and used to estimate the distribution of Fermi momenta of the nucleons in the copper nucleus. Author (TAB)

N66-24872# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Institut für Metallurgie.
MEASUREMENT OF SURFACE CONTAMINATION OF EMULSIFIELD PARTICLES BY FISSIONABLE MATERIAL [MESSUNG DER OBERFLACHENVERUNREINIGUNG VON BESCHICHTETEN TEILCHEN DURCH SPALTBARES MATERIAL]
K. H. Buchner and P. Koss 1966 29 p refs In GERMAN Submitted for Publication
(SGAE-M-4/1966) CFSTI: HC $2.00/MF $0.50

The surface contamination of pyrolytic carbon coated nuclear fuel spheres with fissionable impurities was examined by suspending the coated particles in graphite powder and subsequent exposure to thermal neutron radiation. The fissionable material in the graphite powder was then measured after removal of the spheres. This method made it possible to obtain only the degree of surface contamination in the coating layer without added values from leaks and cracks in the structure of the fuel elements. Transl. by G.G.

N66-24877# European Organization for Nuclear Research, Geneva (Switzerland).
MEASUREMENT OF THE POLARIZATION AND THE SPIN CORRELATION PARAMETERS IN THE PROTON-PROTON DIFFUSION AT 600 MeV WITH THE AID OF A POLARIZED PROTON TARGET [MESURE DES PARAMETRES DE POLARISATION ET DE CORRELATION DE SPIN DANS LA DIFFUSION PROTON-PROTON A 600 MeV A L'AIDE D'UNE CIBLE DE PROTONS POLARISES]
G. Coignet 19 Jan. 1966 77 p refs In FRENCH
(CERN-66-2)

A highly polarized proton bundle was devised to analyze carbon at 575 MeV from four angles. By using this bundle with a target of polarized protons, the angular distribution of polarization parameters and spin correlation was measured. Since a synchrocyclotron had been used to accelerate the protons to 600 MeV, a feasibility study was made of the proton-proton scattering at this energy. As a result of the experiments, the scattering matrix was reconstructed and the efficacy of new techniques, such as the use of a polarized target, was demonstrated. Transl. by R. Li.

N66-24882# Aktiebolaget Atomenergi, Stockholm (Sweden).
NEUTRON SCATTERING IN HYDROGENOUS MODERATORS STUDIED BY TIME DEPENDENT REACTION RATE METHOD
L. G. Larsson, E. Möller, and S. N. Purohit Mar. 1966 31 p refs
(AE-223) CFSTI: HC $2.00/MF $0.50

The moderation and absorption of a neutron burst in water, poisoned with the non-1/v absorbers cadmium and gadolinium, has been followed on the time scale by multigroup calculations, using scattering kernels for the proton gas and the Nelkin model. The time dependent reaction rate curves for each absorber display clear differences for the two models, and the separation between the curves does not depend much on the absorber concentration. An experimental method for the measurement of infinite medium reaction rate curves in a limited geometry has been investigated. This method makes the measurement of the time dependent reaction rate generally useful for thermalization studies in a small geometry of a liquid hydrogenous moderator, provided that the experiment is coupled to programs for the calculation of scattering kernels and time dependent neutron spectra. Good agreement has been found between the reaction rate curve, measured with cadmium in water, and a calculated curve, where the Haywood kernel has been used. Author

N66-24885# European Atomic Energy Community, Brussels (Belgium).
TRAPPING OF KRYPTON IN URANIUM CARBIDE SURFACES
O. Gautsch and C. Mustacchi Mar. 1966 26 p refs
(EUR-2749.e) CFSTI: HC $2.00/MF $0.50

The trapping of Kr in UC surfaces during neutron irradiation was investigated and about 10^{13} atoms of Kr were found embedded per $cm^2 \times atm$. of Kr after 5×10^{18} thermal nvt. Trapping of Kr was also observed in CaF_2 and Au which were thermally evaporated and recondensed in presence of Kr. The Kr concentration in the recondensed layers was $2 \cdot 10^{-4}$ and $3 \cdot 10^{-5}$ atoms of Kr per atom of solid and unit Kr pressure, for CaF_2 and Au respectively. Author

N66-24888# Warsaw Univ. (Poland). Dept. of Radiochemistry.
NEUTRINOS IN SUPERDENSE MATTER. III: ON PARTIALLY EXTERNAL TRAJECTORIES [NEUTRINA W SUPERGESTEJ MATERII. III: O TORACH POLOZONYCH CZESCIOWO NA ZEWNATRZ]
Bronislaw Kuchowicz Jan. 1966 26 p refs
CFSTI: HC $2.00/MF $0.50

In a preceding paper it was shown that for certain values of parameters the neutrinos can move in a stationary way inside an incompressible fluid sphere. It is shown now, for another interval of parameters that the neutrinos may cross the boundary of the sphere. The highest value of the distance

from the centre at which neutrinos may be found on a stationary non-hyperbolic trajectory is equal to 4/3 r_1, where r_1 is the geometrical radius of the sphere. Author

N66-24901# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
GAMMA RAYS FROM INELASTIC SCATTERING OF 14.1 MeV NEUTRONS ON C^{12} AND O^{16} [PROMIENIOWANIE GAMMA Z NIEELASTYCZNEGO ROZPRASZANIA NEUTRONOW 14, 1 MeV NA JADRACH C^{12} I O^{16}]
T. Kozlowski, W. Kusch, and J. Wojtkowska Sep. 1965 11 p refs
(INR-661/IA/PL) CFSTI: HC $1.00/MF $0.50

Gamma rays following the inelastic scattering of 14.1 MeV neutrons were measured using the associated particle method. Differential cross-sections for the production of 4.34 MeV gamma rays from C^{12} and for 6.14 MeV gamma rays from O^{16} were determined. Author

N66-25016*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
APPLICATION OF UNITARY TRANSFORMATIONS TO FOURTH ORDER PERTURBATION THEORY
J. L. M. Cortez Washington, NASA, May 1966 65 p refs
(NASA-TN-D-3441) CFSTI: HC $3.00/MF $0.75 CSCL 20J

Perturbation theory is used to obtain energy corrections to the energy of a nondegenerate stationary system. The unitary transformation method is used to obtain the energy corrections to fourth order. In the first section, a short introduction is given to the usual perturbation techniques. In subsequent sections, the higher order corrections are given in a somewhat detailed manner. The purpose of this approach is to point out the difficulties encountered in using a formalism to obtain useful formulae suitable for numerical calculations. Author

N66-25027# International Centre for Theoretical Physics, Trieste (Italy).
BROKEN SYMMETRY AND THE SMUSHKEVICH PRINCIPLE
P. Narayanaswamy and T. S. Santhanam 15 Dec. 1965 13 p refs Submitted for Publication
(IC/65/91)

An attempt is made to incorporate broken SU(2) symmetry of iso-spin into a dynamical scheme based on the Smushkevich principle. It is found that a unique solution to the problem is possible only if conservation of electric charge is assumed, resulting in a simple sum rule for the physical pion-nucleon coupling constants. The possibility of extending this method to higher symmetries is discussed. Author (NSA)

N66-25028# European Organization for Nuclear Research, Geneva (Switzerland).
BARYON RESONANCES
Robert D. Tripp 15 Apr. 1965 73 p refs Presented at the Varenna Intern. School of Phys. on Strong Interactions, Varenna, Italy, Jul. 1964 Revised
(CERN-65-7, Rev.)

Elementary scattering theory is outlined. A discussion of the Breit-Wigner equation is given with particular emphasis on those characteristic aspects that are identifiable in scattering experiments. As a specific example the $Y_0^*(1502)$ is discussed in detail. Other baryon resonance are discussed with emphasis on those that have been discovered more recently and those whose quantum numbers are still uncertain. NSA

N66-25031# International Centre for Theoretical Physics, Trieste (Italy).
DYNAMICAL GROUPS OF SIMPLE NON-RELATIVISTIC MODELS
A. Bohm Nov. 1965 30 p refs Submitted for Publication
(IC/65/82)

The construction of the generators of the dynamical group of the nonrelativistic rotator and the hydrogen atom is discussed. Author (NSA)

N66-25033# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
GAVER—A NEUTRON CROSS SECTION AVERAGING PROGRAM
C. V. Smith and M. K. Drake 1 Sep. 1965 21 p
(Contract AT(04-3)-167)
(GAMD-6892) CFSTI: HC $1.00/MF $0.50

The computer program GAVER, which was written for use on the IBM 7044 to compute average cross sections for a set of fine energy groups, is described. The program listing is included, together with sample input and output. NSA

N66-25035# International Centre for Theoretical Physics, Trieste (Italy).
DYNAMICAL GROUP AND MASS SPECTRUM
A. Bohm Nov. 1965 10 p refs Submitted for Publication
(IC/65/83)

A relation between the representation of the Poincaré group and the (4+1) de Sitter group is introduced, and it is shown that this relation provides a selection procedure for the mass spectrum which leads to an experimentally correct mass formula. Author (NSA)

N66-25041# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Atomnoi Energii
ANALYSIS OF POLARIZATION IN A NEUTRON BEAM BY SCATTERING ON THE COULOMB FIELD OF THE NUCLEUS [ANALIZ POLYARIZATSII V PUCHKE NEITRONOV RASSEYANIEM NA KULONOVSKOM POLE YADRA]
N. S. Lebedeva 1965 4 p ref In RUSSIAN
(IAE-901)

An expression for the Coulomb scattering amplitude is given, obtained previously by Schwinger, assuming that the small-angle elastic scattering amplitude is independent of neutron spin and that the imaginary part of the small-angle nuclear scattering amplitude can vary for forward scattering. The expression is used to derive an equation for the polarization of neutrons scattered on the Coulomb field of a heavy nucleus, which gives polarization in terms of the total cross section and the differential cross section at two points. NSA

N66-25042# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
A GENERALIZATION OF TWO-DIMENSIONAL MODEL OF BORN-INFELD FIELD TO THE CASE OF SEVERAL INTERACTING FIELDS AND THE QUANTIZATION OF THIS SYSTEM [OBOBSHCHENIE DVUKHMERNOI MODELI POLYA BORNA-INFELDA NA NESKOLKO VZAIMODEISTVUYUSHCHIKA POLEI I KVANTOVANIE ETOI SISTEMY]

B. M. Barbashov and N. A. Chernikov 1965 18 p refs In RUSSIAN
(JINR-P-2311)

On the basis of the solution of the Cauchy problem for the scalar two-dimensional field model of Born-Infeld, a procedure of this field quantization is developed. Since in the classical solution of the Cauchy problem the time t and the x-coordinate are treated as components of a new field, then, as a result of a quantization of this field t and x turn out to be the operators besides the wave function of the field. The geometrical treatment of the model as an external surface is a three-dimensional pseudodimensional pseudoeuclidean space leads to its natural generalization to the case of several interacting fields. The generalized model is regarded as a two-dimensional extremal surface in the many-dimensional pseudoeuclidean space. Author (NSA)

N66-25043# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
CLASSIFICATION OF BOSON RESONANCES IN W_3 SYMMETRY MODEL [KLASSIFIKATSIYA BOZONNYKH REZONANSOV V MODELI W_3-SIMMETRII]
Ya. Kvetsinski 1965 6 p refs In RUSSIAN submitted for publication
(JINR-P-2392)

A classification of the known boson resonances in the W_3 symmetry scheme is suggested. It is shown that in the case of (1^+1^-) mesons the mass formulas of the broken W_3 symmetry are fulfilled with an accuracy of some percent. The presence of additional 0^+ and 2^- mesons follows from the scheme. Approximate values of their masses are determined. Author (NSA)

N66-25044# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
INELASTIC PARTICLE INTERACTIONS AT HIGH ENERGIES. I: COMPOSITION AND MULTIPLICITY OF SECONDARY PARTICLES [NEUPRUGIE VZAIMODEISTVIYA CHASTITS PRI BOLSHIKH ENERGIYAKH. I: SOSTAV I MNOZHESTVENNOST VTORICHNYKH CHASTITS]
V. S. Barashenkov, V. M. Maltsev, I. Patera, V. D. Toneev 1965 70 p refs In RUSSIAN Submitted for publication
(JINR-P-2393)

The experimental data available at present at $T \geq 0.8$ Bev are reviewed. Detailed tables of these data and their theoretical analysis are given. Author (NSA)

N66-25075# Columbia Univ., New York. Dept. of Physics.
INFRAPARTICLE STRUCTURE AND FUNCTIONAL INTEGRALS
Jan Tarski [1965] 17 p refs
(Contract AT(30-1)-755)
(TIP-22390) CFSTI: HC $1.00/MF $0.50

An investigation of functional integral representations, in terms of the fermion Green's functions for given external fields, was made. Some representations which involve the Hilbert space integral are presented. An analysis of the charged sectors of Schroer's model is presented. NSA

N66-25076# Maryland Univ., College Park. Nuclear Emulsion Group.
PARTICLE DATA FOR MESIC HYPERNUCLEI Technical Report No. 501
Sep. 1965 46 p refs
(Contract AT(40-1)-2504)
(TID-22398) CFSTI: HC $2.00/MF $0.50

Tabulations of particle data for all mesonically decaying hypernuclei observed by the Nuclear Emulsion Group at Maryland are presented. Particle ranges given are as measured and are not normalized to standard emulsion densities. NSA

N66-25081# Syracuse Univ., N. Y. Theoretical Elementary Particle Physics Group.
RESEARCH PROGRAM IN ELEMENTARY PARTICLE THEORY Second Progress Report, Period Ending 30 Nov. 1965
[1965] 50 p refs
(Contract AT(30-1)-3399)
(TID-22452) CFSTI: HC $2.00/MF $0.50

Theoretical research toward the development of a theory for elementary particles is presented. Information is listed under separate heading of applications of the theory of symmetry groups, dynamics and dispersion relations, group theory, origin of symmetry and bootstraps, and field theory. NSA

N66-25085# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
RAM—AN IBM-7094 MONTE CARLO CODE FOR CRITICALITY CALCULATIONS
E. Cupini and A. De Matteis Nov. 1965 29 p refs
(RT/FIMA(65)5)

RAM is an IBM-7094 Monte Carlo code suitable for multigroup criticality calculations for small fast assemblies. The main purpose of the code is to find K_{eff} and the energy-space distribution of neutrons in many-zoned spherical or cylindrical (r,z) geometries. The nuclear reactions considered are absorption, elastic and inelastic scattering, and fission. Author (NSA)

N66-25088# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
THE ISU(2) × ISU(3) CONTENT OF THE ISU(6) REPRESENTATIONS
M. Grynberg and M. Pindor Apr. 1965 14 p refs
(INR-623/VII/PH)

On the basis of the connection between the linear group and the permutation group, a method was formulated for finding the $SU_2 \otimes SU_3$ content of an irreducible representation of SU_6. Results were obtained for tensors of rank 3, 6, and 9. NSA

N66-25087# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
IDENTIFICATION OF RADIOELEMENTS ACCORDING TO THEIR RADIOACTIVITY [IDENTIFICATION DES RADIOELEMENTS PAR LEUR RADIOACTIVITE]
Jacques Proupert Nov. 1965 27 p refs In FRENCH
(CEA-Bib-62)

Studies showed that the identification of radioelements based on radioactivity is possible due to a great variety of techniques. In the presence of an unknown radioelement, it is necessary first of all to determine the nature of the radiation emitted; this is easily done using an absorption method for example. When this has been established, it is possible to complete the identification of the radioelement using its period or its energy, or even using a combination of these two measurements when one alone is not sufficient. Normal

half life measurement techniques make it possible to determine this parameter for values of from a few seconds to several years. The energy measurements are usually carried out by absorption or spectrometry. 53 references are cited.
Author (NSA)

N66-25092# Brookhaven National Lab., Upton, N. Y.
NUCLEAR SPIN-PARITY ASSIGNMENTS. ANGULAR CORRELATIONS OF INTERNAL PAIRS
E. K. Warburton and D. E. Alburger [1965] 40 p refs Presented at Am. Phys. Soc., Gatlinburg, Tenn.
(Contract AT(30-2)-GEN-16)
(BNL-9637; CONF-651118-2) CFSTI: HC $2.00/MF $0.50

The angular correlation of internal pairs was utilized in an intermediate-image pair spectrometer to determine the multipolarities of nuclear electromagnetic transitions. The method consists of measuring the pair-line yield using a special spiral baffle system which selects positron-electron pairs emitted at large relative angles and comparing this with the yield without the baffle. Ratios $R_\omega = (Y_{\text{with baffle}})/(Y_{\text{without baffle}})$ were calculated theoretically for various multipoles and are found to fit accurately the data for calibration lines of known multipolarity. Unknown lines are then compared with the master set of R_ω curves. Corrections for nuclear alignment effects are discussed. A review is given of the work done to date with this device designated as a multipole meter, and measurements on transitions from the 5.96-Mev level of ^{10}Be are reported. It is shown that this state is a doublet, one member of which is $J^\pi = 1^-$ decaying predominantly by an E1 ground-state transition and the other member of which has even parity decaying predominantly to the 3.37-Mev first-excited state of ^{10}Be. A critique of the method is presented and future applications are discussed. Author (NSA)

N66-25098# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.
THE ELASTIC SCATTERING OF 160 MeV PROTONS FROM Be-9, Ca-40, Ni-58, Sn-120 AND Pb-208
Philip G. Roos and N. S. Wall Jul. 1965 26 p Prepared in Cooperation with Maryland Univ. *Its* Tech. Rept.-475
(Contract AT(30-1)-2098)
(TID-22478) CFSTI: HC $2.00/MF $0.50

Using a good resolution total energy scintillation spectrometer the elastic scattering differential cross sections of 160-Mev protons from ^{9}Be, ^{40}Ca, ^{58}Ni, ^{120}Sn, and ^{208}Pb were measured. Optical model analyses of the data were made, and the pertinent parameters are given. The most significant result of the analyses is that the extent of the imaginary part of the optical potential is of the order of 10^{-13} cm greater radius than the real part of the potential, independent of atomic weight. Author (NSA)

N66-25099# Junta de Energia Nuclear, Madrid (Spain). Division de Fisica.
ANTIPROTON-PROTON ELASTIC SCATTERING AT 3.0 AND 4.0 GeV/C [DIFUSION ELASTICA ANTIPROTON-PROTON A 3,0 Y 4,0 GeV/C]
Salome Unamuno (Ph.D. Thesis) May 1965 76 p refs In SPANISH
(JEN-161-DF/I-50)

The elastic scattering of antiprotons by protons at 3.0 and 4.0 Bev/c was investigated by observing two-prong intersections in a hydrogen bubble chamber exposed to antiproton beams. The elastic and total cross sections were obtained at both energies. The results were compared with data on antiproton–proton scattering at different energies and on proton-proton scattering. Interpretation of the results by several optical models was attempted. NSA

N66-25102# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.
ELECTROPRODUCED ISOBARS $N_{3/2}$ (1238) IN RELATIVISTIC SU(6) SYMMETRY $SU(6)_w$ SYSTEM [ELEKTRORODZHDENIE IZOBARY $N_{3/2}$ (1238) V SKHEME RELYATIVISTSKOI SU(6) SIMMETRII $SU(6)_w$]
B. V. Geshkenbein 1965 7 p refs In RUSSIAN; ENGLISH Summary *Its* Rept.-377
(NP-15787)

The cross section for the electroproduction of the $N^*_{(2)}$ resonance was calculated on the basis of a relativistic SU(6) symmetry. The transition form factor and the proton magnetic form factor were evaluated and were found to coincide in the range of momentum transfer from $q^2 = 2F^{-2}$ to $100F^{-2}$.
NSA

N66-25105# Oak Ridge National Lab., Tenn.
CALCULATED FLUXES OF LESS THAN 50-MeV NEUTRONS DIFFUSING BENEATH THE SHIELD OF A MESON PRODUCTION FACILITY
W. E. Kinney [1965] 8 p refs Presented at the 13th Conf. on Remote Systems Technol., Washington
(Contract W-7405-ENG-26)
(ORNL-P-1787; CONF-651101-49) CFSTI: HC $1.00/MF $0.50

A Monte Carlo calculation was performed in an attempt to estimate the effect of the "earthshine" in an idealized but useful shield configuration. Some crude biasing techniques were employed in an effort to improve the results. The methods used in this calculation are discussed and some results and conclusions are presented. NSA

N66-25108# Stanford Univ., Calif. Stanford Linear Accelerator Center.
THE W-SPIN RELATIVISTIC VERSION OF SU(6) AND ITS EXPERIMENTAL TESTS
Haim Harari Oct. 1965 28 p refs Presented at the Symp. on High-Energy Phys., Boulder, Colo., Aug. 1965
(Contract AT(04-3)-400)
(SLAC-PUB-148; CONF-650837-2) CFSTI: HC $2.00/MF $0.50

Some of the difficulties encountered in the various versions of "relativistic SU(6)" are discussed with the conclusion that a nontrivial chain of subgroups is obtained, which may serve as a chain of approximate symmetries for some special sets of processes. In particular the group $SU(6)_W$, which has been proposed as a possible underlying symmetry for collinear processes, is studied. Some of its experimental tests are discussed. In most cases a good agreement is obtained between the theoretical predictions and the experimental data. NSA

N66-25111# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
SOME CHARACTERISTICS OF A BEAM OF NEUTRONS PRODUCED BY 9 GeV PROTON INTERACTION WITH Be TARGET AT THE JINR SYNCHROPHASOTRON [NEKOTORYE KHARAKTERISTIKI PUCHKA NEITRONOV, OBRAZUYUSHCHIKHSYA PRI VZAIMODEISTVII PROTONOV S KINETICHESKOI ENERGIEI 9 GeV S MISHENYU IZ Be NA SINKHROFAZOTRONE JINR]

Yu. D. Zernin, V. I. Moroz, V. A. Nikitin, V. A. Sviridov, and Yu. A. Troyan 9 Nov. 1965 8 p refs In RUSSIAN
(JINR-P-2424)

Using NIKFI-R emulsions, the mean energy and angular distribution of the neutron beam produced by the interaction of 9-Bev protons with Be are measured in the angle interval 0 to 6° of the lab. system. At 0° the average energy of neutrons is found to be 6.6±0.7 Bev. Author (NSA)

N66-25112# Joint Inst. for Nuclear Research, Dubna (USSR).
THE POLARIZATION TENSOR IN SCATTERING OF POLARIZED NUCLEONS ON A PROTON TARGET [TENZOR POLYARIZATSII PRI RASSEYANII POLYARIZOVANNYKH NUKLONOV NA POLYARIZOVANNOI PROTONNOI MISHENI]
I. Bilenkaya, P. Vinternits, F. Legar, and Z. Yanout 3 Sep. 1965 10 p refs In RUSSIAN
(JINR-P-2399)

The tensor components were calculated and discussed according to the phase shift data in the energy range 23.1 to 630 Mev. Author (NSA)

N66-25114# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
REGGE POLES AND MANDELSTAM REPRESENTATION IN POTENTIAL THEORY [POLES DE REGGE ET REPRESENTATION DE MANDELSTAM EN THEORIE DU POTENTIEL]
Daniel Bessis (Ph.D. Thesis—Paris Univ.) 1965 135 p refs In FRENCH
(CEA-R-2753)

The scattering of two spinless particles interacting through a superposition of Yukawa potentials is analyzed. An upper bound is obtained for the scattering amplitude for complex values of the energy and angular momentum. It is shown that the Regge poles are confined to small domains of the complex angular momentum plane, and the variation of these domains with energy is studied. An upper bound for the double spectral function is derived and is used to show that the Schroedinger equation implies the Mandelstam representation for the type of potentials considered. NSA

N66-25115# Johns Hopkins Univ., Baltimore, Md. Dept. of Physics.
NUCLEAR REACTIONS IN LIGHT NUCLEI AND MOSSBAUER STUDIES
David A. Goldberg et al Nov. 1965 162 p refs
(Contract AT(30-1)-2028)
(TID-22403) CFSTI: HC $5.00/MF $1.00

Studies are reported on: the ^{57}Fe Moessbauer effect in Fe and Fe_2O_3, as studied using Van de Graaff-induced (d,p) reactions and Coulomb excitation; ^{57}Fe γ-ray absorption by sodium ferrocyanide; an analysis of all possible Moessbauer nuclei; Moessbauer studies of the internal conversion coefficients of the first excited state in ^{169}Tm, produced by beta decay of ^{169}Er; detection of Moessbauer effect in ^{57}Fe 137-kev transition from the second-excited state; Moessbauer effect in ^{57}Fe at high temperatures; the polarization of ^{57}Fe nuclei by the Moessbauer effect; Moessbauer measurements of the proton spectra and ^{13}B polarization from $^{11}B(d,p)^{12}B$ reactions at 2.8 and 3 Mev; mechanisms and distributions for $^{19}F(d,n)^{20}Ne$; the design of a pulsed ion source for the Johns Hopkins 3-Mev Van de Graaff accelerator; and instrumentation for Moessbauer measurements. NSA

N66-25119# Syracuse Univ., N.Y. Dept. of Physics.
SOULD SU(3) MASS FORMULAS FOR MESONS USE THE MASSES OF THE MESONS OR THEIR SQUARES?
A. J. Macfarlane and R. H. Socolow (Latin Am. School of Phys., Mexico City) Nov. 1965 21 p refs
(Contract AT(30-1)-3399)
(NYO-3399-44) CFSTI: HC $1.00/MF $0.50

The practice of using squares of masses in mass formulas for SU_3 meson multiplets, which arose originally in order to bring the Gell-Mann–Okubo mass formula for the 0^- meson octet more nearly into agreement with experiment, is criticized. The basis of the criticism is that X^0–η mixing can make the Gell-Mann–Okubo formula compatible with the observed 0^- meson spectrum not only when one applies it to the squares of the masses, but also when one applies it to the masses themselves. Of course, the degree of the mixing is different in the two cases and this affects the prediction of decay rates. Accordingly, the decays of 2^+ mesons into two 0^- mesons are discussed in considerable detail as an example of a situation where experimental measurements may discriminate between the values of the mixing angle corresponding to linear and quadratic mass formulas. Author (NSA)

N66-25120# Franklin Inst., Swarthmore, Pa. Bartol Research Foundation.
STUDIES ON ELECTROMAGNETIC PROPERTIES OF EXCITED STATES OF NUCLEI Annual Progress Report, 1965
F. R. Metzger 13 Dec. 1965 72 p refs
(Contract AT(30-1)-3525)
(TID-22462) CFSTI: HC $1.00/MF $0.50

Studies of strongly perturbed γ–γ angular correlations were carried out using gaseous and metallic sources of ^{127}Xe. A two-rotor facility capable of relative velocities of 3600 mi/hr was designed, built, and tested. Resonance scattering experiments were carried out with ^{42}Ca, ^{125}Te, ^{159}Tb, and ^{193}Ir, using radioactive isotopes in the gaseous phase or in conjunction with the high speed rotor facility. Theoretical studies were concerned with the shell model description of isobaric analog excitations, the spreading of these excitations due to the Coulomb interaction, and the particle widths of analog states. NSA

N66-25126# International Centre for Theoretical Physics, Trieste (Italy).
REGGE POLES IN QUANTUM ELECTRODYNAMICS
T. Pradhan and Mamata Pattnaik Dec. 1965 12 p refs submitted for publication
(IC/65/87)

With a view to investigating the large momentum transfer limits of Compton scattering amplitude, the perturbation theory matrix elements for the scattering of massive photons (mass=λ) by electrons are considered. Since setting $\lambda=0$ in the asymptotic limits of these matrix elements need not necessarily give the desired answer because of the two different limiting procedures involved, one separates those parts of the matrix elements that diverge on setting $\lambda=0$ from the rest that remains finite, keep λ finite but small compared to m (electron mass) in the former, set $\lambda=0$ in the latter and then obtained the large momentum transfer limits of both separately. It is found that up to 6th order in perturbation theory the large momentum limits are consistent with Regge asymptotic behavior. The Regge parameter $\alpha(W)$ has a λ-dependent part for $W>m$ which diverges logarithmically for $\lambda\to0$. The matrix element corresponding to this part in $\alpha(W)$ is cancelled by terms arising from corrections to the scattering amplitude due to emission of real soft photons from external electron lines. Since these corrections depend on the

resolution of the apparatus for detecting the soft photons, the location of the Regge trajectory for W>m will depend on the experimental arrangement. However, for W=m and in the immediate vicinity of it $\alpha(W)$ has no λ-dependent part (this is in keeping with the fact that infra-red divergence does not arise when the particles are off the mass shell). The trajectory is, therefore, well defined near W=m and has the definite value zero at W=m. One therefore concludes that the electron is a Regge pole. Author (NSA)

N66-25127# European Atomic Energy Community, Brussels (Belgium). Reactor Physics Dept.
A PROGRAMME FOR THE SOLUTION OF THE MONO-ENERGETICAL TRANSPORT EQUATION IN THE P5 AP-PROXIMATION FOR A MULTIREGION CYLINDRICAL GEO-METRY
L. Massimo 5 Oct. 1965 40 p refs
(EUR-2584.e)

A computer program which solves the monoenergetic transport equation in the P_5 approximation for a multi-region cylindrical geometry is described. The program is written in FORTRAN II for the IBM 7090. NSA

N66-25128# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Atomnoi Energii.
ON VARIATION OF RESONANCE NUCLEAR PARAMETERS IN SCATTERING ON REGULAR SYSTEMS [OB IZMERENII REZONANSNYKH YADERNYKH PARAMETROV PRI RAS-SEYANII NA REGULYARNYKH SISTEMAKH]
Yu Kagan and A. M. Afanas'ev 1965 20 p refs In RUSSIAN
(IAE-940)

Scattering on systems of nuclei with low-lying resonance levels is studied. It is found that, if the nuclei form a regular one-dimensional chain or two-dimensional lattice, then the elastic width and the position of the resonance level undergo substantial changes. It is shown that the change of the width is associated with the lifetime of the collective excited state of the system of nuclei. The lifetime of such a state and the corresponding width can be both larger and smaller than the lifetime (width) of an isolated excited nucleus. It is shown that in the case of a three-dimensional crystal the elastic width, in general, disappears and the energy dependence of the resonance interaction is determined only by the inelastic width. In the presence of spin in the ground state of the nu-cleus and if inelastic scattering through phonons plays a noticeable role, the (width) takes a value intermediate between the inelastic width and the total width. Author (NSA)

N66-25129# India. Dept. of Atomic Energy, Bombay. Nu-clear Physics Div.
NUCLEAR DATA ACTIVITIES IN INDIA, VOLUME II Sec-ond Progress Report
Jul. 1965 39 p refs submitted for publication
(AEET-228)

Experimental studies of reactions, decays, energy levels, and spectra of nuclei are outlined. Also discussed are neutron-scattering studies of solids. NSA

N66-25131# Joint Inst. for Nuclear Research, Dubna (USSR).
SPIN CORRELATION TENSOR IN THE SCATTERING OF POLARIZED NUCLEONS ON A POLARIZED PROTON TAR-GET [TENZOR SPINOVOI KORRELYATSII PRI RASSEYANII POLYARIZOVANNYKH NUKLONOV NA PROTONNOI POL-YARIZOVANNOI MISHENI]
P. Winternitz, F. Legar, and Z. Yanout 25 Oct. 1965 40 p refs In RUSSIAN
(JINR-P-2407)

Experiments concerning the spin correlation tensor C in the scattering of polarized nucleons on polarized protons are discussed. Relativistic formulas are derived for the experi-mental quantities. Components of C are predicted for the energies 23.1, 40, 52, 95, 147, 210, 310, 400, and 630 MeV on the basis of various sets of phase shifts, and are given on graphs. The scattering matrix is directly reconstructed with the help of experimentally measured quantities.
Author (NSA)

N66-25132# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
SUM RULES FOR PHOTON ABSORPTION BY NUCLEONS AND THE MAGNETIC MOMENT FOR THE TRANSITION $N \rightarrow N^*_{3,3}$ IN THE QUARK MODEL [PRAVILA SUMM DLYA POGLOSHCHENIYA FOTONOV NUKLONAMI I MAGNIT-NYI MOMENT PEREKHODA $N \rightarrow N^*_{3,3}$ V MODELI KVARKOV]
S. B. Gerasimov 17 Nov. 1965 6 p refs In RUSSIAN
(JINR-P-2439)

Dipole sum rules for photon absorption by nucleons are obtained within the nonrelativistic Quark model. Some quali-tative properties of the energy dependence of the cross sec-tions of the electric dipole and magnetic dipole photon ab-sorption are pointed out. The Beg, Lee, and Pais formula for the magnetic moment of the transition $N \rightarrow N^*_{3,3}$ is com-pared with experiment. It is shown that the divergence be-tween theory and experiment is about 10%. Author (NSA)

N66-25133# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ONE-DIMENSIONAL SCATTERING PROBLEM ON A TWO-PARTICLE SYSTEM WITH A DISCRETE SPECTRUM [ODN-OMERNAYA ZADACHA RASSEYANIYA NA SISTEME DVUKH CHASTITS S DISKRETNYM SPEKTROM]
I. S. Lupashina and S. N. Sokolov 3 Nov. 1965 10 p refs In RUSSIAN
(JINR-P-2418)

A problem is considered of particle scattering on a system of two particles which cannot dissociate. The convergence is proved of an infinite system of integral-differential equations, for potentials for which the spacing between levels is mono-tonically increasing with energy. Author (NSA)

N66-25134# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics
MESON RESONANCES 2^+, 1^+, 0^+ IN THE HIGHER SYM-METRY THEORY [MEZONNYE REZONANSY $2+$, $1+$, $0+$, V TEORII VYSSHIKH SIMMETRII]
Kao Ti, Nguyen van Hieu, and Bronislaw Sredniava 20 Oct. 1965 34 p refs In RUSSIAN
(JINR-P-2400)

Mesons of spin and parity 2^+, 1^+, 0^+ in SU(6) theory and its relativistic generalizations are considered. The con-nection between the representations 225 and 441 of the group U(6) and the representations $4212+$ and $5940+$ is explained with the aid of the scheme GL(6). It is shown that meson resonances A_2, K_T, and f_0 may belong to the repre-sentation $4212+$ as well as to $5940+$. Explicit expres-sions are given for the decay widths of all $2+$ mesons and the matrix elements for $1+$ and $0+$ mesons with particular values of isospin and hypercharge. Author (NSA)

N66-25135# California Univ., Berkeley. Lawrence Radiation Lab.

NUCLEAR MAGNETIC MOMENTS AND HYPERFINE ANOMALIES OF Re^{186}, Re^{188} AND Am^{241} Am^{242}

Lloyd Armstrong, Jr. (Ph.D. Thesis) 23 Sep. 1965 93 p refs
(Contract W-7405-ENG-48)
(UCRL-16419) CFSTI: HC $3.00/MF $0.75

The nuclear magnetic moments of ^{186}Re, ^{188}Re, ^{241}Am, and ^{242}Am were measured using the method of triple resonance in an atomic beam. The hyperfine anomalies for Am and Re were determined from the experimental values. In addition, the hyperfine structures of Am and Re were calculated relativistically. It was found that relativistic effects alone explain the hyperfine structure of Re, but that both relativistic effects and core polarization are needed to explain the hyperfine structure of Am. The nuclear moments of Am and Re were also calculated by the Nilsson model. NSA

N66-25136# California Univ., Livermore. Lawrence Radiation Lab.

GENERAL NON-DYNAMICAL FORMALISM FOR REACTIONS WITH PARTICLES OF ARBITRARY SPIN. NUMBER OF FORM FACTORS. PARITY CONSERVATION

Paul L. Csonka, Michael J. Moravcsik, and Michael D. Scadron Dec. 1965 88 p refs
(Contract W-7405-ENG-48)
(UCRL-14582-T) CFSTI: HC $3.00/MF $0.75

The general non-dynamical formalism for reactions involving particles of arbitrary spins is further developed. The number of form factors in the M-matrix is determined under parity conservation as well as other conservation laws, and from this it is derived that many conservation laws have no non-dynamical tests of validity in reactions involving spin-zero particles only. The factorization of the M-matrix into irreducible constituents is developed for parity conserving reactions, and it is shown how the compound observable can be written down in terms of observables and so-called pseudo-observables of the constituent reactions. It is then demonstrated that for parity conserving reactions, an unpolarized and uncorrelated particle is, in general, equivalent to a spin-zero particle possessing both positive and negative parity (dual particle). The structure of observables in terms of the type of traces they contain is studied. The number of terms in a compound observable is derived. It is also shown that the number of observables in a parity conserving reaction is always larger than the number of independent bilinear combinations of form factors. Thus, there are always linear relations among the observables. The number and character of these relations are explored and it is shown that they also lead to the complete list of parity experiments, i.e., experiments from which one can determine the intrinsic parity of one of the particles in the reaction, knowing the intrinsic parities of the other participating reactions but knowing nothing about the dynamics of the reaction. It is also shown that the observables can be divided into subclasses, a given subclass containing observables which are different linear combinations of the same bilinear combinations of form factors. Each such bilinear combination appears in one and only one subclass. Finally, the set of instructions to calculate observables, given in one of the previous papers for reactions for which only rotation invariance is assumed, is supplemented to take into account the simplifications brought about by the additional assumption of parity conservation. Author (TAB)

N66-25137# Oak Ridge National Lab., Tenn.

SOME CONCLUSIONS REGARDING THE USE OF THE S_n METHOD IN SHIELDING CALCULATIONS

J. Wallace Webster 15 Sep. 1965 56 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1196) CFSTI: HC $3.00/MF $0.75

Neutron penetration in hydrogen and water from a point source of fission neutrons was studied using the S_n method. The results were compared with results obtained using the moments method. NSA

N66-25139# California Univ., Berkeley. Lawrence Radiation Lab.

K DECAY

George H. Trilling 17 Nov. 1965 46 p refs Presented at the Intern. Conf. on Weak Interaction, Argonne, Ill., 25–27 Oct. 1965
(Contract W-7405-ENG-48)
(UCRL-16473; CONF-651043-3) CFSTI: HC $2.00/MF $0.50

A critical survey of measured K-meson decay modes is presented. The accuracies of results are evaluated. The agreement between the experimental data and theoretical predictions is discussed. NSA

N66-25143# Princeton-Pennsylvania Accelerator, Princeton, N. J.

POSITRON MOMENTUM SPECTRUM FROM K^+_{e3} DECAY

Paul T. Eschstruth (Ph.D. Thesis—Princeton Univ.) 1 Oct. 1965 111 p refs
(Contract AT(30-1)-2137)
(PPAD-571-F) CFSTI: HC $4.00/MF $0.75

In the decay $K^+ \rightarrow \pi^0 + e^+ + \nu$, the positron momentum spectrum is measured in the range 60 to 230 Mev/c, using stopped K^+ mesons from a 47° beam at the Princeton-Pennsylvania accelerator. The positrons are identified with a gas Cherenkov counter and their momentum measured with a standard deviation of approximately 2 percent by means of thin-plate spark chambers situated in a magnetic field between the Cherenkov counter and the stopping region. The experimental distribution, containing 1850 events, is consistent with that to be expected for vector coupling. Upper limits for scalar and tensor admixtures (in terms of intensity) are found to be 10 and 2 percent respectively. The K^+_{e3} branching ratio is calculated to be (5.42±0.34) percent. Author (NSA)

N66-25149# Smithsonian Astrophysical Observatory, Cambridge, Mass.

PARTICAL EVAPORATION FROM EXCITED NUCLEI

Henri E. Mitler 11 Mar. 1966 refs
(SAO Special Rept.-204)

Semiempirical analytic formulas were developed for the mean number of neutrons, protons, and heavier particles evaporated from nuclei excited to a given energy. Additionally, the total mass loss was determined. An expression is given for determining the level density and it is reported that it provides better correlation to existing data. The variation of nuclear temperature during an evaporation chain was found and it is stated that the results agree with previous calculations. An expression was derived for the energy spectra of evaporated neutrons for both single and sequential decays and a discussion of its derivation is included. H.S.W.

N66-25204# Oak Ridge National Lab., Tenn.

NUCLEAR THEORY INDEX FOR 1964

M. J. Martin and H. Ogata, ed. [1965] 106 p refs
(TID-22771) CFSTI: $2.50

This booklet presents bibliographic references for nuclear theory papers. Generally, only articles dealing with the low

energy aspects of nuclear theory are indexed. Meson effects are included only as they relate specifically to nuclear properties usually associated with low energy phenomena. Major categories are nuclear structure, models, properties, and reactions; electromagnetic radiation; beta decay and parity; alpha decay; tables and computational aids; and special topics. C.T.C.

N66-25211# California Univ., Livermore. Lawrence Radiation Lab.

PRODUCTION OF METASTABLE ATOMS BY ELECTRON IMPACT

Jerry T. Dowell (Ph.D. Thesis) 9 Dec. 1965 60 p refs
(Contract W-7405-ENG-48)
(UCRL-14450) CFSTI: HC $2.00/MF $0.50

The excitation of metastable states in He, Ne, Ar, Kr, and Xe by electron impact is studied near threshold as a function of electron energy. The RPD method is used for energy selection of the electron beam, yielding a resolution of 0.1 eV. Results in He, Ne, Ar, and Kr are consistent with those of other investigators. Metastable production in each of the gases studied exhibits two major peaks in addition to other structure. These peaks are associated in energy with groups of excited states and may be interpreted as resonances with compound states of the electron-atom collision complex having short lifetimes for decay by autoionization. In krypton, the lowest energy peak is due to excitation of the lowest metastable state alone. Both peaks in the xenon data are due to the lowest metastable state. The energy region close to threshold is studied in detail for each gas, and it is found that a peak or steplike rise occurs within 0.1 eV of threshold in Ar, Kr, and Xe. No such behavior is found in He or Ne. Author (NSA)

N66-25214# Oak Ridge National Lab., Tenn.

R-MATRIX APPROACH TO COMPLEX ANGULAR MOMENTUM AND TO THREE-PARTICLE INTERACTION

Ralph Roskies (Ph.D. Thesis—Princeton Univ.) Jan. 1966 96 p refs
(Contract W-7405-ENG-26)
(ORNL-3914) CFSTI: HC $3.00/MF $0.75

A brief review of the R-matrix formalism for two-particle elastic scattering via a spherically symmetric potential is presented. Properties of the R-matrix are developed as a function of complex energy, or of complex angular momentum. Regge poles in potential scattering are discussed from an R-matrix point of view. The analytic properties of the S matrix as a function of complex energy for arbitrary (i.e., nonintegral) real angular momentum, concentrating especially on the multivalued nature of S as a function of energy, and on the behavior of S near threshold are discussed. The analytic properties of S for real energy and complex angular momentum are discussed, studying the location of the poles of S, and their trajectories as functions of the energy. A brief analysis of some limitations of R-matrix theory is presented. R-matrix theory is generalized to discuss a restricted three-body problem, one in which there are no two-particle interactions. The analytic structure of the S-matrix is then studied as a function of complex total energy, emphasizing the multivaluedness of S, its threshold behavior, and the location of its poles. Finally, the connection between the asymptotic form of the wave function for an incident plane wave, and our S-matrix was investigated. Some general features of three-body elastic scattering are described. The three different types of collisions (two-body, sequential, and real three-body collisions) are distinguished. The diagrams in perturbation theory are identified that are associated with each collision and it is found that the different types of collisions give rise to T-matrix elements of different dimensions. A time-dependent account of three-body elastic scattering is discussed, and the analogs of cross section for each type of collision are defined. NSA

N66-25229# Stanford Univ., Calif. Stanford Linear Accelerator Center.

CONSOLIDATION OF RESULTS OF PRELIMINARY BEAM TESTS WITH SECTORS 1 AND 2

Sep. 1965 108 p ref
(Contract AT(04-3)-400)
(SLAC-50) CFSTI: HC $3.00/MF $0.75

The results of beam tests on sectors 1 and 2 of the two-mile linear accelerator are presented. Separate discussions are presented for klystron performance, operation of the phasing system, typical energy spectra, klystron energy contribution, recycling and replacement, beam dynamics, guidance, and transmission, beam measurements of coupler asymmetry and girder alignment, and the overall system operation. NSA

N66-25241# Argonne National Lab., Ill.

PHYSICS DIVISION SUMMARY REPORT, JANUARY-MARCH 1965

[1965] 55 p refs
(Contract W-31-109-ENG-38)
(ANL-7029) CFSTI: HC $2.00/MF $0.50

Research accomplishments are summarized in experimental nuclear physics, mass spectroscopy studies, and general theoretical physics. Studies with a broad-range magnetic spectrograph are given and include experimental investigations of actinide nuclei with (d,p), (d,t), and (d,d') reactions. A description is given of a combination gamma spectrometer which makes use of a Ge-diode gamma-ray detector in conjunction with a 7.7-m bent-crystal spectrometer. Atomic beam studies are summarized, and the installation of a 2-MeV Van De Graaff generator is reported. Mass spectroscopy investigations include measurements of the kinetic energy released in the fragmentation of ion-molecule complexes. Scattering analyses are presented, and include descriptions of criteria that enable an experimenter to select a set of angles at which an angular distribution should be measured in order that the resulting set of measurements should determine the distribution with minimum uncertainty. C.T.C.

N66-25279# Lockheed Missiles and Space Co., Sunnyvale, Calif.

ON SOME EXPERIMENTAL ESTIMATES OF ELECTRICAL POLARIZABILITY COEFFICIENTS OF NUCLEONS

Iu. A. Aleksandrov and G. S. Samosvat 1965 21 p refs
Transl. into ENGLISH of a paper presented at the Vi All-Union Inter-Univ. Conf. on Elementary Particle Theory, Uzhgorod, USSR, Oct. 1965

The electrical and magnetic polarizability of nucleons is discussed. The scattering of gamma quanta by protons, deuterons and He^4 was investigated. Expressions for the proton polarizability coefficients were determined. Neutron polarizability was estimated from data on the Compton effect and the photoproduction of pions by a deuteron. The upper bound of the electrical polarizability of the neutron was obtained from neutron scattering by heavy nuclei. Electromagnetic interactions of nucleons taking account of their polarizability due to the cloud of virtual electron-positron pairs for the proton and neutron are described. N.E.N.

N66-25292# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
THE SOLUTION OF A STARK EFFECT MODEL AS A DYNAMICAL GROUP CALCULATION
G. Flamand Feb. 1966 26 p refs
(Th/134) CFSTI: HC $2.00/MF $0.50

A model for the Stark mixing of orbital states in the annihilation of particles at rest is solved using dynamical group techniques. The Schrödinger equation for the problem is given meaning in a representation of the three dimensional rotation group and reduced to a two dimensional linear homogeneous differential equation. Author

N66-25325# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE THEORETICAL INTERPRETATION OF RESONANCE DISSOCIATIVE ATTACHMENT CROSS SECTIONS
Donald Rapp, Terry E. Sharp, and Donald D. Briglia [1964] 48 p refs
(LMSC-6-74-64-45)

Resonance dissociative attachment in gases can be theoretically characterized, according to the Franck-Condon principle, in terms of an overlap integral between an initial state of X_2 and a repulsive state of X_2 which dissociates. According to a simplified interpretation of this analysis, the cross section is obtained from a projection of the wave function of the initial X_2 on the repulsive curve of X_2. One then obtains a cross section of the form of a single resonance peak if X_2 is entirely in the ground vibrational state. If the X_2 potential curve crosses the energy of $X+X^-$ in the Franck-Condon region, a vertical onset in cross section at this energy is predicted. If this occurs, an unequivocal determination of the electron affinity of X is obtained without resort to kinetic energy measurements. It appears that CO and H_2 may be examples of this situation. The effect of vibrational excitation in the initial molecule is discussed in terms of this model, and detailed calculations are made for O_2. Author

N66-25329# Oak Ridge National Lab., Tenn.
CALCULATION OF THE NUCLEON-MESON CASCADE IN IRON INITIATED BY 1-GeV AND 3-GeV PROTONS AND COMPARISON WITH EXPERIMENT
R. G. Alsmiller, Jr. and J. Barish Dec. 1965 24 p refs
(Contract W-7405-ENG-26)
(ORNL-3852) CFSTI: HC $1.00/MF $0.50

One-dimensional nucleon-meson cascade calculations were carried out for the cases of 1- and 3-GeV protons incident on steel. The thick target cross sections are calculated and compared with experimental values. The calculated values are generally larger than the experimental values for large depths. Author (NSA)

N66-25330# Los Alamos Scientific Lab., N. Mex.
FISSION PRODUCT YIELD FROM FAST (~1 MeV) NEUTRON FISSION OF Pu-239
Carl A. Anderson, Jr. 30 Dec. 1965 29 p refs
(Contract W-7405-ENG-36)
(LA-3383) CFSTI: HC $2.00/MF $0.50

The sixteen measured yields of fission products from fast fission of Pu-239 published through June 1965 are given. Information is presented which indicates the restricted range of mass numbers within which mirroring, or reflection, of data is applicable. Use of this information enables generation of fairly reliable guesses for six reflected data points. A curve fit to these data provides interpolated estimates of unmeasured mass chain yields. A modified equal-charge-displacement hypothesis is used to estimate independent and cumulative fission yields of nuclides. Author (NSA)

N66-25362# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.
APPLICATION OF FINITE POTENTIALS TO NUCLEAR MATTER. I: PERTURBATION THEORY
Donald W. L. Sprung Nov. 1965 39 p refs
(Contract AT(30-1)-2098)
(MIT-2098-201) CFSTI: HC $2.00/MF $0.50

The application of second-order perturbation theory to nuclear matter was simplified by the definition and tabulation of a set of generalized Euler functions. Explicit expressions were derived for the contributions of all the potential terms that are likely to be required in a two-nucleon interaction. The formalism was applied to Bressel's potential, a modified Hamada-Johnston potential in which the infinite hard cores are replaced by finite square potentials. NSA

N66-25362# Oak Ridge National Lab., Tenn.
ON THE BOUND STATES OF AN ELECTRON IN THE FIELD OF A PERMANENT ELECTRIC DIPOLE
J. E. Turner and Kenneth Fox Dec. 1966 56 p refs
(Contract W-7405-ENG-26)
(ORNL-3895) CFSTI: HC $3.00/MF $0.50

An exact analysis based on Hamilton-Jacobi theory shows that electronic bound states exist classically for arbitrarily weak dipoles. A quantum mechanical analysis using a trial function of the form $\Psi = \exp(-\alpha r^t)(C_0 Y_{00} + C_1 Y_{10})$, where C_0, C_1, α, and t are variational parameters, Y_{00} and Y_{10} are S- and P-state angular momentum eigenfunctions, and r is the electron's radial coordinate, shows that a bound state exists in the field of both a point dipole and a finite dipole (in the limit of very weak binding) with a dipole moment as small as 1.65×10^{-18} esu-cm. This is lower than the smallest value of Wallis et al. A semiclassical argument based on the uncertainty principle suggests that there is a minimum value of the dipole moment required to bind an electron. A rough estimate indicates that the minimum value may be $D = 0.2 \times 10^{-18}$ esu-cm. NSA

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N66-23869# Oregon Univ., Eugene. Dept. of Physics.
CONNECTED-DIAGRAM EXPANSION OF TRANSPORT COEFFICIENTS. II: QUANTUM GAS OBEYING CLASSICAL STATISTICS
Shigeji Fujita Feb. 1966 34 p refs
(Contract Nonr-2771(05))
(TR-7; AD-628248) CFSTI: HC $2.00/MF $0.50

A connected diagram expansion method is applied in the evaluation of the correlation function formulas for transport coefficients of an imperfect quantum gas obeying the classical statistics. The diagram expansion is independent of representation and could be applied to charged particles subjected

to a magnetic field. The formal fugacity expansion of a transport coefficient is obtained in terms of the solution of a transport equation, which is in general linear and inhomogeneous. This expansion is in agreement with that derived by Kawasaki and Oppenheim, Phys. Rev. 139, A649 (1965), for a classical gas except for part of the field term. This formal expansion has a divergence difficulty. This difficulty can be eliminated by the summation of partial infinite fugacity series. It is shown that after the elimination of the difficulty, the expansion in powers of the density should be approximately valid at least in the first few orders. Terms in the combination of n (density) and ln n do not arise. Author (TAB)

N66-23893# Ohio State Univ. Research Foundation, Columbus.

RESEARCH ON ROTATING rf FIELD PLASMA Final Report, 1 Oct. 1964–30 Sep. 1965

Marion L. Pool Jan. 1966 15 p refs *Its* Rept.-1
(Grant AF-AFOSR-202-65)
(AFOSR-66-0408; AD-628930) CFSTI: HC $1.60/MF $0.50

Two-phase, ion cyclotron frequency power put to a magnetic bottle has produced a hydrogen plasma over a wide range of pressures. Electrons and ions which escape from the ends of the bottle have maximum energies in the neighborhood of 12 keV, as indicated by multi-diffused junction detector with a depletion depth of 0–100 microns. A 30-joule diagnostic laser was used for measuring electron densities in the region of 10^{13} per cc. A Fabry–Perot interferometer, with an interference filter for the Hα 6563 A hydrogen line, was assembled for photographing the Haidinger rings. From the line-broadening measurements an energy of 18 eV was estimated for the neutral hydrogen atoms in the plasma. Ferrite cores were tested at 4.0 megacyles in a 5000-gauss B_z magnetic field. The results encouraged the design of an ensemble of two eight-group, two-phase coils. This ensemble is being fabricated for the purpose of creating stronger revolving magnetic and rotating electric fields. Author (TAB)

N66-23894# General Electric Co., Philadelphia, Pa. Space Sciences Lab.

EXTRA THERMAL IONIZATION AND MHD FLOWS Final Report

Arthur Sherman 15 Oct. 1965 5 p refs
(Contract AF 49(638)-1465)
(AFOSR-65-2237; AD-628065) CFSTI: HC $1.00/MF $0.50

Investigation is described of the interaction between extra-thermal ionization and MHD flows. The motivation for such research has been related research (experimental) into crossed field devices utilizing extra-thermal ionization to enhance electrical conductivity. Author (TAB)

N66-23903# General Electric Co., Philadelphia, Pa. Missile and Space Div.

HYPERSONIC RAREFIED PLASMA FLOWS Final Progress Report

Sinclaire M. Scala Nov. 1965 9 p refs *Its* Rept.-214-W53 (Final)
(Contract AF 49(638)-1283)
(AFOSR-66-0365; AD-628924) CFSTI: HC $1.10/MF $0.50

The report deals with research in hypersonic rarefied gas dynamics. For a single component gas techniques for a hypersonic approximation to the moment equations were considered and a paper written on their application to the problem of source flow expansion. For gas mixtures a multi-fluid hydrodynamic theory was developed for a disparate mass mixture. In addition, work on the numerical solution of the nonlinear Boltzmann equation was continued. Author (TAB)

N66-23904# Northwestern Univ., Evanston, Ill. Gas Dynamics Lab.

MICROWAVE DIAGNOSTICS OF ARC-HEATED NITROGEN AND AIR PLASMAS Final Report

Harold M. Waller Aug. 1965 52 p refs
(Contract AF 49(638)-879; Grant AF-AFOSR-329-63)
(B-2-65; AFOSR-66-0363; AD-628918) CFSTI: HC $3.00/MF $0.50

Electrical properties of arc-heated nitrogen and simulated air plasma flows were studied using microwave diagnostic techniques. The plasmas were produced by running nitrogen through a commerical plasma jet with a supersonic nozzle attached downstream. Oxygen is mixed with the nitrogen plasma just upstream of the throat of the supersonic nozzle in order to produce the simulated air plasma. Electron densities and collision frequencies were determined from measurements of the phase shift and attenuation of E-band microwaves transmitted through the plasma. The microwave frequencies used were 76.9 and 82.4 kMc and for both air and nitrogen plasmas the following properties were determined: electron density, attenuation constant, and collision frequency. These properties are presented as function of h_{gas} a measure of the electrical power input to the plasma, which ranged up to 36 kilowatts. The experimental results are compared with available theoretical predictions and qualitative agreement is found. Author (TAB)

N66-23905# Socony Mobil Oil Co., Inc., Princeton, N. J. Research Dept.

PLASMA DENSITY BY ION BEAM PROBING; DENSITY AND SPECTROSCOPIC MEASUREMENTS OF ENERGETIC DEUTERIUM ARCS Final Scientific Report, 1 Dec. 1964–30 Nov. 1965

Robert L. Hickok, Forrest C. Jobes, John F. Marshall, and Samuel L. Duncan Jan. 1966 92 p refs *Its* Rept.-1
(Contract AF 49(638)-1500)
(AFOSR-66-0285; AD-628890) CFSTI: HC $9.60/MF $0.75

The radial density distribution in a magnetically confined, energetic deuterium arc was measured by probing the arc with a 1.8 MeV deuteron beam. Integrated densities along a beam path were determined by measuring the proton production rate from the D (d,p) H^3 reaction between the deuterons in the beam and in the arc. A zone calculation was used to invert the proton production data to a radial density distribution. Peak densities on the arc axis are in the range of 10^{13} to 10^{14} and the radius of the half density point is in the range of 1 to 2 cm. Spectroscopic observations of the arc were also made. Comparison with estimated spectral intensities, based on the density distribution and electron temperature, indicated that for high arc currents the neutral density is determined by the recombination rate but for low arc currents there appears to be an excess of neutral atoms. Macroscopic arc parameters, such as current and voltage, have been used, together with the density distribution, in an idealized model of the arc to obtain values for the average electron temperature and plasma space potential. Author (TAB)

N66-23927*# Institute for Defense Analyses, Arlington, Va. Jason Div.
Kenneth M. Case, Marvin L. Goldberger, Samuel B. Treiman, and Kenneth M. Watson Jan. 1966 37 p refs
(Contract ARPA SD-50)
(IDA-HQ-65-4071; P-202; AD-629684) CFSTI: HC $3.60/MF $0.50

The paper provides a basis for a detailed description of rf breakdown of the atmosphere in the vicinity of a conical reentry vehicle which is transmitting an rf signal to earth. It derives relatively simple equations governing the electromagnetic, chemical, and hydrodynamic processes accompanying breakdown near a re-entry vehicle. An application is made to several idealized models. Author (TAB)

N66-24239# Electro-Optical Systems, Inc., Pasadena, Calif.
STUDIES OF ELECTRICALLY EXPLODING WIRES AND FILMS. STUDIES OF CROSSED-FIELD PLASMA ACCELERATORS AND PLASMA DIAGNOSTIC TECHNIQUES Final Summary Report, 1 Apr. 1961-30 Sep. 1965
Norman C. Chase and Donald P. Duclos Oct. 1965 210 p refs
(Contract AF 49(638)-1063)
(EOS-1690-Final; AFOSR-66-0154; AD-628034) CFSTI: HC $6.00/MF $1.25

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1. STUDIES OF ELECTRICALLY EXPLODING WIRES AND FILMS N. C. Chase 107 p refs (See N66-24240 13-25)

2. ON THE ACCELERATION OF SPHERES BY ONE-DIMENSIONAL NON-UNIFORM GAS FLOWS 26 p refs (See N66-24241 13-12)

3. STUDIES OF CROSSED-FIELD PLASMA ACCELERATORS AND PLASMA DIAGNOSTIC TECHNIQUES D. P. Duclos 64 p refs (See N66-24242 13-25)

N66-24240# Electro-Optical Systems, Inc., Pasadena, Calif.
STUDIES OF ELECTRICALLY EXPLODING WIRES AND FILMS
Norman C. Chase *In its* Studies of Electrically Exploding Wires and Films. Studies of Crossed-Field Plasma Accelerators and Plasma Diagnostic Tech. Oct. 1965 107 p refs (See N66-24239 13-25) CFSTI: HC $6.00/MF $1.25
(EOS-1690-Final, Pt. I)

The results of experiments designed to produce a directed, metal-derived plasma with high kinetic energy, which might result in development of a high performance propulsive device, are presented. Three experimental methods are described. In the first, the plasma produced by rapid Joulean heating is converted into directed kinetic energy by means of a material nozzle. The method is rejected because of nozzle erosion and cooling of the plasma by the confining walls. The second method uses a rail-type accelerator. Kerr cell studies, however, indicate the greatest amount of plasma acceleration to be caused by magnetic backstrapping. This led to development of the third and most effective method, in which a pure backstrap accelerator is used. The advantages of the final method derive from lower inductance of the wire holder, less erosion of the electrodes, and a design which permits all high-voltage connections to be made outside the vacuum system.
Author

N66-24242# Electro-Optical Systems, Inc., Pasadena, Calif.
STUDIES OF CROSSED-FIELD PLASMA ACCELERATORS AND PLASMA DIAGNOSTIC TECHNIQUES
Donald P. Duclos *In its* Studies of Electrically Exploding Wires and Films. Studies of Crossed-Field Plasma Accelerators and Plasma-Diagnostic Tech. Oct. 1965 64 p refs (See N66-24239 13-25) CFSTI: HC $6.00/MF $1.25
(EOS-1690-Final, Pt. II)

The performance and operating characteristics of dc crossed field plasma accelerators operated at low and high channel pressures and an ac low pressure crossed field plasma accelerator were determined. The thrust ratio for the ac accelerator was comparable to that for the dc accelerators, but the efficiency was lower. The physical phenomena that occur in the dc accelerator channels were studied both experimentally and analytically. Current, potential, and electron temperature distributions were measured. Due to Hall effects, the current distribution was found to be unsuitable for producing a high accelerator efficiency. Channel pressures and potential distributions were measured in the high pressure dc accelerator. Due to Hall currents, the pressure near the cathode surface exceeded the pressure near the anode. A technique for measuring the ion density in a plasma which was not affected by the presence of a magnetic field or the absence of thermodynamic equilibrium was developed. The technique consisted basically of exciting the ions with a proton beam and relating the measured absolute intensity of certain spectral lines to the ion density. Author

N66-24313# Library of Congress, Washington, D. C. Aerospace Technology Div.
PLASMA DIAGNOSTICS BY MICROWAVES
Stuart G. Hibben *In its* Foreign Sci. Bull., Vol. 2, No. 2 Feb. 1966 p 1-7 refs (See N66-24312 13-34)

Discussions are provided on combinations of ordinary and extraordinary microwave probing of plasmas. Axial as well as transverse beaming of the test signal are analyzed. Results are given of tests in which plasma densities, collision frequencies, and other data were found by the suggested techniques.
Author

N66-24402*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
EXTENSION OF THE FOKKER-PLANCK EQUATION
John C. Price (Calif. Univ., Berkeley) Mar. 1966 18 p refs
(NASA-TM-X-55466; X-641-66-96) CFSTI: HC $1.00/MF $0.50 CSCL 20I

A simple collision term valid to order $1/\ln \Lambda$ is derived for small amplitude waves in a uniform plasma. This result extends the validity of Fokker-Planck type equations from the domain $0 \leq \omega << \omega_p$, $0 \leq k << k_d$ to the domain $0 \leq \omega << \Lambda\omega_p$, $0 \leq k \gtrsim k_d$.
Author

N66-24406*# Geophysics Corp. of America, Bedford, Mass.
SPUTTERING ION SOURCE Final Report, 29 Mar.-30 Sep. 1963
Richard F. K. Herzog and Helmut J. Liebl [1963] 42 p Prepared for JPL
(Contracts NAS7-100; JPL-950576)
(NASA-CR-74626; GCA-TR-63-7-G) CFSTI: HC $2.00/MF $0.50 CSCL 20I

A sputtering ion source for the analyses of solids was modified by replacing the solenoid with a permanent magnet to prevent component breakdown in case of flashover. The new duoplasmatron showed superior performance compared with the standard spark source in regard to precision of analysis. So far, the choice of samples was limited because of interference with instrumental background that needs further investigation. Generally, the parent peak of the single charged

ion was the largest; intensities of double charged ions and of diatomic ions were lower by about one order of magnitude. Intensities of triply charged ions and the triatomic ions were lower by two orders of magnitude. Quadruply charged ions were not detected. However high polymeric ions were found; in the case of aluminum as high as Al_{10}. G.G.

N66-24425# Nihon Univ., Tokyo (Japan).
ATOMIC ENERGY RESEARCH INSTITUTE OF NIHON UNIVERSITY Annual Report, 1965
[1965] 89 p refs
(NUP-66-7) CFSTI: HC $3.00/MF $0.75

Research activities are reported. Experimental and theoretical plasma physics research includes: theta pinch plasmas; magnetic probe measurements; neutral and charged gas flows; electron density measurements using lasers; plasma oscillations; high temperature plasmas; plasma instabilities; and solid state plasmas. Solid state research covers superconductors and magnetic properties of rare earth system and chromium system intermetallics. Theoretical physics studies encompass elementary particles, quantum field theory, and low temperature physics. Also presented are a bibliography of publications, a list of preprints, and a report of studies in the history of science. D.T.

N66-24433# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
ELECTRICAL CONDUCTIVITY MEASUREMENTS IN A FARADAY ACCELERATOR
Raymond Goldstein, J. Kenneth Richmond, and Gordon C. Oates Nov. 1965 29 p refs /ts Flight Sci. Lab. Rept. No. 101
(D1-82-0486)

This paper discusses the results of an experimental study of a potassium seeded-argon atmospheric pressure Faraday accelerator. Electrical conductivity, with and without applied magnetic field, temperature of the electrodes, and potential distributions across the channel were measured. The potential distributions across the channel, measured by means of Ta wires embedded in the sidewalls, show very large wall sheaths. Since the electrode temperatures are sufficiently high to give good thermionic emission, these large sheath voltage drops indicate the presence of thick boundary layers of low electrical conductivity. In the presence of a transverse magnetic field the measurements show that the boundary layers become thinner, as predicted by theory. The values of conductivity measured across the central core of the flow are compared with predictions of Kerrebrock's two-temperature theory, and the agreement between the measured and calculated values is good. Author

N66-24462# Utah Univ., Salt Lake City. Dept. of Metallurgy.
ORIGIN OF DETONATION-GENERATED IONIZATION WAVES
Melvin A. Cook and Dix A. Newell 15 Sep. 1965 36 p refs
(Grant AF-AFOSR-56-65)
(AFOSR-65-1918; AD-629231) CFSTI: HC $2.00/MF $0.50

The high electron density which exists in the external ionization wave that propagates away from the free surface of a detonating explosive was investigated by electrostatic probes and an impurity-doping method. Two impurities, potassium nitrate and cesium nitrate, were added to RDX in different molar concentrations. The conduction in the ionization wave was measured by the electrostic probe technique. The increased maximum conduction at the front of the ionization wave and the increased thickness of the wave for doped RDX as compared with conduction measurements obtained with pure RDX were discussed in terms of two current models for the origin of the ionization wave—the shock wave model and the detonation generated plasma model. Author (TAB)

N66-24584*# Case Inst. of Tech., Cleveland, Ohio.
AN EXPERIMENTAL STUDY OF THE RELATIONSHIP BETWEEN MOVING STRIATIONS AND PLASMA-ACOUSTIC WAVES
D. A. Meskan [1965] 105 p refs
(Grant NsG-198)
(NASA-CR-74607; A-40) CFSTI: HC $4.00/MF $0.75 CSCL 20I

The velocity, attenuation, and frequency of moving striations in the positive column of a hot cathode glow discharge are determined experimentally. Plasma-acoustic wave dispersion relations which would be appropriate for explaining these striations by means of a linear fluid model are derived. The properties of various large amplitude waves predicted by nonlinear fluid models are discussed. A comparison of the striations' behavior and the plasma-acoustic wave theories demonstrates that the frequently assumed relationship between these two phenomena does not exist. The experiments were performed in an argon discharge at pressures from 20 to 480 mtorr, and with discharge current densities on the order of 25 ma/cm^2. Typical electron densities and temperatures were 2×10^{10}cm^{-3} and 2×10^{4}°K. The velocity of the striations varied from 2.1×10^{5} to 1.3×10^{4} cm/sec., while the frequency varied from 6×10^{2} to 2.3×10^{4} cycles per second. Author

N66-24649# Boeing Scientific Research Labs., Seattle, Wash.
STABILITY DIAGRAMS FOR MAGNETOGASDYNAMIC CHANNEL FLOW
F. D. Hains May 1965 33 p refs Presented at Meeting of Am. Phys. Soc., Pasadena, Calif., 23–25 Nov. 1964 /ts Flight Sci. Lab. Rept.-97
(D1-82-0438)

A study is made of the influence of a coplanar magnetic field on the stability of a conducting fluid flowing between parallel planes. After derivation of the general stability equations for small magnetic Reynolds number, numerical results are obtained for the case where initial perturbations of the magnetic field vanish. This must occur if the channel walls have zero or infinite conductivity. Four sets of stability diagrams are presented so that each stability curve will represent the effect of a given applied magnetic field as only one of the four quantities in the Reynolds number is changed. The flow is always stable for initial disturbances of the field produced by passage of a pulsating current through walls of finite conductivity. Author

N66-24670# Harvard Univ., Cambridge, Mass. Engineering Sciences Lab.
THE ARC MEASUREMENT OF HIGH TEMPERATURE GAS TRANSPORT PROPERTIES
H. W. Emmons Dec. 1965 45 p refs
(Grants NSF GK-65; NSF GP-414)
(TR-23)

A confined electric arc for the measurement of gas transport properties is developed to the point that the resultant properties are found within a few percent. The measurements include the arc electrical gradient characteristic, the flow pressure drop, the radiative heat transfer, the spectral temperature distribution, and microwave resonance characteristics. Values of the electrical and thermal conductivity of equilibrium argon

are tabulated for the temperature range from 7500°K to 13,750° K. Helium in the confined arc at atmospheric pressure up to 400 A is shown not to be in thermodynamic equilibrium and hence its equilibrium properties cannot be thus measured. Author

N66-24678# RAND Corp., Santa Monica, Calif.
TABULATED SOLUTIONS OF THE EQUATION GOVERNING MAGNETOHYDRODYNAMIC FLOW WITH ALIGNED VELOCITY AND MAGNETIC FIELDS
S. Berger, S. Genensky, A. Madansky, and M. Ryan Apr. 1966 51 p refs
(Contract ARPA SD-79; ARPA Order 189-1)
(RM-4847-ARPA)

A solution is presented for the second-order linear partial differential equation for the stream velocity of an infinitely conducting gas flow with aligned velocity and magnetic fields. Linearization is accomplished by transformation to the hodograph, or velocity, plane; and equations are thereby reduced to those of ordinary gas dynamics. A series solution is presented which is valid for small velocities; and asymptotic formulas are given which can be used when the separation constant, which is an integer, takes on larger values. Tabulations are listed separately for various magnetic field intensities, which are expressed in terms of stagnation Alfven numbers. Values are given for both velocities between zero and the smallest value for which the differential equation again becomes singular, as well as for quantities obtained by the asymptotic formulas. M.W.R.

N66-24682# International Union of Pure and Applied Chemistry, Basle (Switzerland). Commission on High Temperatures in Gases and on Plasma Chemistry.
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND PLASMAS
31 Dec. 1965 36 p refs
(Rept.-17)

Three separate compilations are given in a bibliography dealing with high temperature chemistry and physics of gases and plasmas. These references, which include only the author, title, and source, are categorized under the headings of: (1) *Spectroscopy of Interest to High Temperature Chemistry*, (2) *Reactions between Gases and Condensed Phases*, and (3) *Thermodynamics of Plasmas*. The first two sections were prepared in the United States, while the last was done in France; and references from many countries are included in all three. M.W.R.

N66-24702# American Meteorological Society, Boston, Mass.
DIFFUSION OF A FULLY IONIZED PLASMA ACROSS A MAGNETIC FIELD [O DIFFUZII POLNOST'IU IONIZOVANNOI PLAZMY POPEREK MAGNITNOGO POLIA]
V. F. Aleksin and N. A. Khizhniak Bedford, Mass., AFCRL, Dec. 1965 9 p refs Transl. into ENGLISH from the book "Doklady, Konferentsiia po Fizike Plazmy i Probleme Upravliaemykh Termoiadernykh Reaktsii" Kiev, Izd-vo Akad. Nauk Ukr. SSR, 1963 p 332-336
(Contract AF 19(628)-3880)
(T-R-467; TT-66-60674; AD-628968) CFSTI: HC $1.00/MF $0.50

In studying the diffusion of charged particles in a weakly ionized plasma, the motion of the charged component of plasma relative to a neutral-particle gas is usually examined. In this case, the coefficient of diffusion is practically independent of the charged-particle density and the diffusion process is described by the ordinary linear equation of diffusion. Author (TAB)

N66-24713# Innsbruck Univ. (Austria). Inst. for Theoretical Physics.
GAS DYNAMIC METHODS IN MHD FLOW Summary Report No. 2 (Final), 1 Jan. 1963-31 Dec. 1965
Ferdinand Cap, G. Kerer, F. Herrnegger, K. Lackner, R. Skerics et al 3 Jan 1966 22 p refs
(Contract AF 61(052)-675)
(AFOSR-66-0405; AD-628917) CFSTI: HC $2.60/MF $0.50

The report contains a brief analysis of the following items: (a) Two-dimensional steady flow (variational method), (b) One-dimensional unsteady flow (variational method), (c) Plasma with finite conductivity (exact solutions), (d) Approximate solutions and linearized equations, (e) New numerical methods, (f) Low conductivity plasma, (g) Applications, (h) Plasma acceleration and MHD power generation. A detailed discussion of future plans is given. Author (TAB)

N66-24730# General Electric Co., Philadelphia, Pa. Missile and Space Div.
DENSITY OF PULSED PLASMA Final Report
Per Gloersen Jun. 1965 21 p refs
(Contract AF 49(638)-1174)
(AFOSR-65-1732; AD-628516) CFSTI: HC $2.60/MF $0.50

An absorption spectroscopy technique in the vacuum ultraviolet region was developed to measure the ion and neutral particle densities in the exhaust stream of a repetitively pulsed two-stage coaxial plasma propulsion engine by monitoring their various resonance absorption lines. The development of the plasma accelerator progressed to the point where argon was definitely ruled out as a suitable propellant. Xenon was found to be suitable and efforts were shifted towards extending the measuring techniques for use with xenon and other heavier propellants. In order to provide a better model for coaxial gun operation than hitherto available, some analytical effort was applied to the problem. The special case of the stationary current sheet was brought to a successful conclusion both on the basis of energetics and the application of Faraday's law, starting from first principles. Extension of this analysis to cover the moving current sheet has been only partly successful to date in that a reasonable statement of the energetics could be made, but no consistent means has yet been found for applying Faraday's law. TAB

N66-24748# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
DISTRIBUTION FUNCTIONS OF A SYSTEM WITH DIFFERENT TEMPERATURES OF THE PARTICLE COMPONENTS
G. Ecker and W. Kroll 27 Jan. 1965 19 p refs
(JILA-28)

A plasma consisting of particle components with different temperatures is considered. The components are uniformly distributed in the configuration space and Maxwellian in the velocity space. Pair correlations are assumed to be small and higher order correlations negligible. It is shown that the influence of the electrons on the ion kinetics can be taken into account by treating the ions as dressed particles. The hierarchy for these dressed particles provides the ion-ion correlation function. The electron-ion pair correlation is calculated from the Poisson equation using the ion-ion correlation and relating the electronion pair distribution to the average potential. By the same procedure the electron-electron correlation is derived using the electron-ion correlation. The results are compared with those of other authors. Author

N66-24816# United Aircraft Corp., East Hartford, Conn. Research Labs.

THEORETICAL RESEARCH ON THERMODYNAMIC AND TRANSPORT PROPERTIES OF GASES AT HIGH TEMPERATURES Final Report

H. H. Michels Jan. 1966 15 p refs
(Contract AF-49(638)-1133)
(UACRL-E910004-12; AFOSR-66-0407; AD-628911) CFSTI: HC $1.00/MF $0.50

The research performed under this contract was directed primarily into two areas. In the first, an analysis of the problems of calculating the thermodynamic properties of a high temperature gas was undertaken in an effort to find reliable methods of extending present data to much higher temperatures. Accurate thermodynamic data are especially required for the high temperature region, perhaps to temperatures reaching 6000°Kelvin for systems deriving their energy from chemical reactions and to substantially higher temperatures for plasma systems. In the second area, an analysis was undertaken of problems associated with the prediction of transport properties in high temperature gas mixtures, especially systems with some degree of ionization or molecular excitation. A precise knowledge of the various interaction potentials between the reacting species is essential for a complete understanding of the high temperature behavior of such systems and for calculating the transport properties. Author (TAB)

N66-24834# Harvard Univ., Cambridge, Mass. Engineering Sciences Lab.

A SPECTROSCOPIC INVESTIGATION OF A HELIUM PLASMA ARC

J. F. Bott Jan. 1966 34 p refs
(Grant NsF GK-65)
(TR-25)

The spectral line radiation from the Poiseuille plasma arc, operated at 100 A and 1 atm pressure in helium, has been investigated. The purpose of this investigation was to determine whether the state of the plasma can be described as being in local thermodynamic equilibrium with a single temperature or whether additional parameters are needed to describe the state of the plasma. The emission coefficient of six helium lines were measured and these results compared to measurements of the Stark broadening of a line. Author

N66-24857# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y. Dept. of Electrophysics.

SURFACE WAVES ON A UNIAXIAL PLASMA SLAB: THEIR GROUP VELOCITY AND POWER FLOW

H. L. Bertoni and A. Hessel 12 Oct. 1965 34 p refs
(Contract Nonr-839(38); ARPA Order-529)
(PIBMRI-1294-65; AD-478432)

The relation between group velocity and the velocity of energy transport for surface waves in plane-stratified, anisotropic, dispersive media is verified by direct calculation for the case of surface waves on a uniaxial, cold plasma slab located in free space. A superimposed D.C. magnetic field of infinite strength and parallel to the interface generates the uniaxial anisotropy in the slab. Surface waves having an arbitrary direction of propagation with respect to the D.C. magnetic field are considered. A useful graphical presentation of the dispersion relation is given, from which the direction of propagation of "surface wave rays" is directly obtained. Author (TAB)

N66-24863# Toronto Univ. (Ontario). Dept. of Electrical Engineering.

GUIDED WAVES ON AN INFINITE CYLINDRICAL CAVITY IN A MAGNETOIONIC MEDIUM

S. R. Seshadri and K. L. Bhatnagar Dec. 1965 60 p refs
(Grant DRB-G-5540-02)
(RR-38; AD-478385)

The characteristics of the guided waves supported by an infinitely long cylindrical cavity of free space immersed in a magnetoionic medium are investigated for the case of the magnetostatic field in the direction of the axis of the column. The frequency characteristics and the dispersion characteristics are studied as a function of the ratio of the gyromagnetic to plasma frequencies, and the radius of the column. For small dimensions of the column, both the fast and the slow portions of the lowest order mode have backward wave regions and the conditions which are sufficient for the existence of the backward waves are discussed. All the other higher order modes are found to be fast forward waves whose phase velocity continuously decreases to approach the free space velocity of electromagnetic waves as the frequency is increased. Author (TAB)

N66-24868# Japan Atomic Energy Research Inst., Baraki. Thermonuclear Research Lab.

EXPERIMENTS ON THE PLASMA FLOW PAST BODIES IN A MAGNETIC FIELD (I)

Nobuki Kawashima and Sigeru Mori Jul. 1965 30 p refs
(JAERI-1999) CFSTI: HC $2.00/MF $0.50

Plasma flows past bodies in a magnetic field are investigated experimentally by the use of a plasma from a plasma gun. The downstream wake of an ordinary hydrodynamic shock wave is observed for a collision-dominant plasma flow. When the body in the plasma flow is a wedge-shaped conductor, the structure of the shock is investigated in detail. The plasma flow is divided into four regions by three characteristic lines; (1) the shock front (2) the separation line of the shock wave from the tail of the wedge and (3) the magnetic line of force passing through the tail of the wedge. When a wake of the shock wave interacts with the other wake, they join into one along the magnetic lines of force. Plasma flows past a wave-shaped wall are also investigated. As the plasma flow becomes collision-free, this downstream wake gradually disappears and no collision-free shock wave is observed. When the plasma flow is sub-Alfvenic, a disturbance propagating upstream along the magnetic lines of force is observed. Author

N66-24871# Nagoya Univ. (Japan). Inst. of Plasma Physics.

RESONANCES OF RADIO FREQUENCY PROBE IN A PLASMA

Hiroyuki Ikezi and Kazuo Takayama Mar. 1966 27 p refs
(IPPJ-48) CFSTI: HC $2.00/MF $0.50

The RF probe experiment is carried out by the use of a low density plasma, and resonances of the probe impedance are studied. We observed two resonances in a frequency range between the sheath-plasma resonance and the plasma frequencies. A mechanism of the additional resonances is discussed. It is shown that finite electron temperature introduces resonances in addition to the sheath-plasma resonance. Choosing some artificial density distributions in front of the probe, the frequency dependence of the resonances is explained qualitatively. Author

N66-24902# Kyoto Univ. (Japan). Dept. of Aeronautical Engineering.

LANGMUIR PROBE MEASUREMENTS IN AN ARGON PLASMA FLOW

Goro Kamimoto and Michio Nishida Nov. 1965 24 p refs
(CP-8) CFSTI: HC $1.00/MF $0.50

Langmuir probe measurements were performed in order to evaluate the properties of the flow in the working section of a plasma jet wind tunnel. A single plane Langmuir probe was used for conditions when the probe collecting surface is parallel to the flow and the diameter of it is of the same order as the mean free path of a neutral atom. Electron temperature, electron density and ion density were calculated from Langmuir probe characteristics. A measured electron temperature is 3×10^3 °K and a measured plasma density is 10^{13} particles/cm^3.
Author

N66-24910*# National Aeronautics and Space Administration, Washington, D. C.
USE OF THE EMISSION SPECTRUM OF THE COPPER ATOM FOR PLASMA DIAGNOSTICS [ISPOL'ZOVANIYE SPEKTRA ISPUSKANIYA ATOMA MEDI DLYA DIAGNOSTIKI PLAZMY]
G. I. Bakanovich and L. I. Grechikhin Apr. 1966 13 p refs Transl. into ENGLISH from Teplofiz. Vysokikh Temperatur. Akad. Nauk SSSR (Moscow), v. 3, no. 4, 1965 p 520–523
(NASA-TT-F-10067) CFSTI: HC $1.00/MF $0.50 CSCL 20I

The temperature and concentration of charged particles in the plasma of a dc arc burning under water are measured from the emission spectrum of copper. The possible errors of measurement are estimated. A method of allowing for the self-absorption of the lines in the temperature determination is given. The Stark constants are calculated for a number of lines, and it is shown that the theoretical values should be used in measuring the concentration of charged particles.
Author

N66-24948*# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.
THE RELATIVISTIC GARDENHOSE INSTABILITY, II
I. Lerche [1966] 25 p refs
(Grant NsG-96-60)
(NASA-CR-74801; EFINS-66-36) CFSTI: HC $1.00/MF $0.50 CSCL 20I

For an anisotropic, spatially uniform, ultra-relativistic plasma, composed of protons and anti-protons (or electrons and positrons), embedded in an infinite, homogeneous magnetic field, we investigate the assumptions that are usually made in discussing the gardenhose instability in the long wavelength, low frequency regime. It is shown that for a particular non-Maxwellian distribution function the usual criterion for instability does not result. Instead of obtaining

$$4\pi(P_{||}-P_{\perp})>H_0^2$$

we obtain $P_{\perp}>P_{||}$ for instability. Thus for non-Maxwellian plasmas we feel that some care should be exercized in dealing with the gardenhose mode.
Author

N66-24978*# Northrop Space Labs., Huntsville, Ala. Research and Analysis Section.
THE VLASOV EQUATIONS
Chih Kang Chou Nov. 1965 89 p refs *Its* Tech. Mem. No. 137
(Contract NAS8-11440)
(NASA-CR-74873; E20-151) CFSTI: HC $3.00/MF $0.75 CSCL 20I

All relevant equations of classical mechanics, classical electrodynamics, and hydrodynamics are either displayed in a suggestive manner or derived from fundamental principles and incorporated in the text of this report. A brief but self-contained review of kinetic theory is given, and the microscopic hydrodynamical equations are derived on the basis of the Boltzmann equation for a dilute neutral gas based on a hard sphere model. Classical statistical mechanics is cast in a form which is particularly suited for its application to plasma dynamics. Liouville's theorem is applied to a relativistic electron gas with a positive ion background. The Vlasov-Boltzmann Equation is obtained from Liouville's theorem on the basis of the self-consistent field formalism of Rostoker and Rosenbluth. The Born-Bogoliubov-Green-Kirkwood-Yvon Hierarchy is derived from the relativistic Liouville's equation. Corrections to the Vlasov-Boltzmann Equation in terms of the multiparticle correlation function technique are also discussed.
Author

N66-25013*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FLOW OF PLASMA IN A SLIGHTLY ROTATIONAL MAGNETIC FIELD
Y. Hiroshige 10 Aug. 1962 17 p refs
(Contract NAS7-100)
(NASA-CR-74848; JPL-TM-33-96) CFSTI: HC $1.00/MF $0.50 CSCL 20I

A solution for a flow of plasma away from the sun in a slightly rotational magnetic field has been determined, assuming that the plasma is incompressible and inviscid and has infinite electrical conductivity. The magnetic field vector is shown to be a constant multiple of the velocity vector, and the problem is reduced to finding the solutions to the vorticity equation and inhomogeneous elliptic-type partial differential equation. An analytic solution is obtained for the case of constant rotation, and streamlines are plotted showing the influence of a rotational field.
Author

N66-25045# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Atomnoi Energii.
HEATING OF ELECTRONS IN A TN-1 APPARATUS [NAGREV ELEKTRONOV V USTANOVKE TN-1]
P. I. Blinov, B. I. Gavrilov, L. P. Zakatov, and P. A. Cheremnykh 1965 8 p refs In RUSSIAN
(IAE-912)

It was previously shown that plasmas may be heated turbulently by means of a pulsed high-frequency circuit. In order to apply this principle for the heating of the electron component of the plasma, the TN-1 machine was constructed. The quasistatic field H_0 reached its maximum of 8 kiloOersted after 5 msec. At a voltage of $U_K=120$ kv and a capacity of $C_K=3\times10^{-9}$ f, the single-loop circuit, with a frequency of 3.5 megahertz created a field of H=900 Oersted. A deuterium-fed coaxial injector made of Ti was used to introduce the plasma into the trap; it was possible to change the plasma concentration from $n_e>2\times10^{13}$ cm^{-3} to $n<10^{11}$ cm^{-3} by changing the voltage. The cold plasma in the trap was decomposed with a time constant $\tau=300$ μsec. It was noted that when the plasma was heated in the concentration range from 10^{12} to 10^{13} cm^{-3}, radial magnetohydrodynamic waves propagated through it. Magnetic probe data indicated that in the case of pinch waves, i.e., when the alternating magnetic field is added to the quasistatic field, the steepness of the wave front becomes increased two to fourfold with respect to the wave in vacuum, in which case the wave is distorted. It was found that electrons with two different energies were present in the system. After filling the trap by means of the injector, a 20-kev X radiation was found for a period of 25 msec; this is probably due to an accelerating mechanism.
NSA

N66-25121# Nagoya Univ. (Japan). Inst. of Plasma Physics.
COLLISION-INDUCED INSTABILITY IN A MAGNETOACTIVE PLASMA

Noboru Shimomura, Kenji Mitani, and Shigetoshi Tanaka
Nov. 1965 32 p refs Submitted for Publication
(IPPJ-43)

The dispersion relations for the waves propagating in a magnetoactive plasma are obtained from the Boltzmann equation with a collision term of the electrons. Two cases in which the wave vector is parallel and perpendicular to a uniform magnetic field are studied. Assuming a δ-function for velocity distribution function, in each case, two dispersion relations for the zeroth approximation in k were obtained. Author (NSA)

N66-25176# Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.

ONSET OF TURBULENCE IN THE POSITIVE COLUMN

F. C. Hoh Feb. 1966 19 p refs
(D1-82-0512)

This note begins with a discussion of a physical stabilization mechanism of the helical instability of the positive column in a longitudinal magnetic field due to quasi-linear effects. The quasi-linear steady state, consisting of a density helix rotating around the axis, is then perturbed and a chain of linearized differential equations results. When this state next becomes unstable, a coupled set of helical modes with the same growth rate are excited simultaneously, thus leading to the onset of turbulent behavior. Finally, the boundary condition and the corresponding expansion of the eigenfunction of the linearized problem, which was arbitrarily chosen previously, is reconsidered. Author

N66-25199# Toronto Univ. (Ontario). Dept. of Electrical Engineering.

MILLIMETER WAVE HARMONIC GENERATION IN A PLASMA

V. Lauks Nov. 1965 66 p refs *Its* Res. Rept. No. 39
(Grant DRB-G-5540-02) CFSTI: HC $3.00/MF $0.75

An experimental study was made to develop an efficient gas discharge harmonic generator at millimeter wavelengths. A suitable configuration was first found at the fundamental frequency of 3 Gc; further experiments were then made at 34 Gc. The 3 Gc system gave a second harmonic conversion efficiency of −7.8 db. The 34 Gc harmonic generator gave a conversion efficiency of −15.2 db and produced 440 milliwatts of power at 68 Gc. The use of higher fundamental frequencies and the possibility of generating more power than presently available at sub-millimeter wavelengths is discussed. Plamsa harmonic generation theory is briefly investigated and a probable explanation for the behavior of the present harmonic generator is given. Author

N66-25217# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.

LINEAR AND NONLINEAR WAVE MOTION IN MAGNETOGASDYNAMICS

J. Bazer and W. B. Ericson Feb. 1966 34 p refs
(RE-240)

Theoretical developments in the solution of propagation and steady state flow phenomena governed by Lundquist equations are surveyed, and various problems that appear to be solvable in the light of these developments are formulated. The medium used is assumed to be an infinitely conducting, nonviscous, compressible gas in which there is embedded a magnetic field. Propagation and steady flow problems in linear theory, and propagation and two dimensional steady flow problems in nonlinear theory are covered. These problems are of basic aerodynamic and geophysical interests. Geometric diagrams are interspersed with the calculations. A list of problems regarding wave motion in magnetofluiddynamics that are of current interest is also given. L.S.

N66-25226# Los Alamos Scientific Lab., N. Mex.

LASL CONTROLLED THERMONUCLEAR RESEARCH PROGRAM Semiannual Status Report, Period Ending Oct. 31, 1965

7 Dec. 1965 93 p refs
(Contract W-7405-ENG-36)
(LA-3434-MS) CFSTI: HC $3.00/MF $0.75

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2. ELECTRON-BEAM PLASMA HEATING J. Mc Leod p 13 ref
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9. ANALOG SOLUTION OF MULTIPOLE STABILIZING CONDUCTORS G. A. Sawyer p 36–38
10. SCYLLACITA, A SMALL THETA-PINCH MACHINE E. Dolnick, R. Dike, E. Kemp, and G. A. Sawyer p 39–41
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14. HYDROMAGNETIC PLASMA GUN PROGRAM I. Henins and J. Marshall p 48–67 refs
15. TRANSVERSE INJECTION J. E. Hammel p 68–70
16. EQUIPMENT DEVELOPMENT AND TESTING I. Henins et al p 71–81
17. NEW MATHEMATICAL PHYSICS GROUP W. B. Riesenfeld p 82–83
18. INVESTIGATION OF dI/B STABLE CLOSED SYSTEMS D. A. Baker p 84–85
19. PLASMA BOUNDARY CALCULATIONS T. A. Oliphant p 86
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21. MAGNETIC MOMENT SERIES H. R. Lewis p 88
22. THERMONUCLEAR REACTOR BLANKETS G. I. Bell p 90 ref

N66-25265# Harvard Univ., Cambridge, Mass. Engineering Sciences Lab.

LAMINAR AND TURBULENT FLOW OF AN ARGON ARC PLASMA

P. W. Runstadler, Jr. Sep. 1965 73 p refs
(Grant NSF GK-65)
(TR-22)

An investigation was conducted to determine how the occurrence of turbulence in a particular flow configuration affects overall plasma properties. Relative to this, progress is reported in establishing a plasma flow in which it is possible to (1) use experimental techniques to establish the flow regime behavior of the plasma, (2) evaluate the characteristics of the laminar mode of flow as an aid in interpreting the turbulent mode, and (3) evaluate the effect of the turbulent mode on the rates of transport of mass, momentum, and energy within the flow. The experimental arrangement is essentially the same as the Poiseuille plasma experiment which has been used extensively to study the thermodynamic and transport properties of high temperature gases. C.T.C.

N66-25340# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
HIGH TEMPERATURE PLASMAS BY LASER HEATING Quarterly Progress Report No. 3, 6 Apr.–5 Jul. 1965
A. V. Phelps 15 Jul. 1965 14 p *its* Res. Memo 65-8E2-139-M3
(Contract AT(30-1)-3472)
(TID-22132) CFSTI: HC $1.00/MF $0.50

The behavior and properties of laser-produced plasmas were investigated using diamagnetic loops, electrostatic probes, framing camera photography, and plasma energy absorption. Particles were successfully suspended electrostatically, but the emphasis remained on the retracting-pedestal approach. NSA

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N66-23908# Massachusetts Univ., Amherst. Polymer Research Inst.
CALCULATION OF CRYSTAL BIREFRINGENCE AND INFRARED DICHROISM IN POLYMERIC SAMPLES FROM X-RAY POLE FIGURE DATA
Richard S. Stein 15 Oct. 1965 31 p refs
(Contract Nonr-3357(01))
(ONR-TR-82; AD-628503) CFSTI: HC $3.60/MF $0.50

In biaxially oriented polymer films, crystal orientation may be characterized by orientation functions evaluated from X-ray pole figure scans for various crystallographic planes. From such orientation functions, one may calculate the crystal contributions to birefringence and infrared dichroism. In addition, the relationships between orientation functions for various hkl planes are considered. The results are dependent upon the symmetry of the unit cell; in the orthorhombic system, the orientation functions for any crystallographic plane may be calculated from experimental values for two planes, while in the hexagonal or tetragonal systems, data on one plane will suffice. Finally, a method for graphical plotting of orientation functions in triangular coordinates is presented. This method has two advantages: a clear, simple visualization of the orientation functions is provided, for both unaxial and biaxial orientation; and the relationships between the orientation functions for different crystallographic planes may be expressed in terms of simple geometrical constructions. Author (TAB)

N66-23921# Cornell Univ., Ithaca, N. Y. Dept. of Engineering Physics.
INVESTIGATIONS OF ATOMIC PHENOMENA OCCURRING ON OR NEAR THE SURFACE OF SOLIDS BY METHODS OF ULTRA HIGH VACUUM ELECTRON DIFFRACTION AND ELECTRON MICROSCOPY Final Scientific Report
Benjamin M. Siegel 1966 7 p refs
(Grant AF-AFOSR-7-62)
(AFOSR-66-0152; AD-628520) CFSTI: HC $1.00/MF $0.50

Publications are listed for these categories: transmission electron diffraction of films deposited in ultra high vacuum, behavior under heat treatment, and the nucleation and growth of the oxide phase; reflection electron diffraction on single crystals, and the nucleation and growth of the oxide phase on different crystal faces; electron microscope characterization of the structure and surface of films deposited and replicated in ultra high vacua; nucleation and growth of crystallites deposited from vapor phase on clean substrates; replication of single crystal surfaces by the ultrahigh vacuum process for surface characterization and investigation of growth phenomena on the surface by electron microscopy. TAB

N66-23926*# Stanford Univ., Calif. Center for Materials Research.
[TOTAL RESEARCH ACTIVITY RELATED TO THE SCIENCE OF MATERIALS] Fourth Annual Technical Report, Jul. 1, 1964–Jun. 30, 1965
[1965] 149 p refs
(Grants NsG-378; NsG-155; NsG-331; NsG-622; NGR-05-020-066 et al)
(NASA-CR-74696; AD-629013) CFSTI: HC $4.00/MF $1.00

This fourth Annual Technical Report includes information on the total research activity related to the science of materials at Stanford University during the period July 1, 1964 to June 30, 1965. The report contains descriptions of the research programs under way during the period, arranged alphabetically by principal investigator. Also included are lists of publications, Ph.D. dissertations, and relevant personnel. TAB

N66-23930# Ballistic Research Labs., Aberdeen Proving Ground, Md. Terminal Ballistics Lab.
A TEST OF VISCOUS DISLOCATION DAMPING THEORY
Nicholas F. Fiore Oct. 1965 26 p refs
(BRL-1298; AD-629557) CFSTI: HC $2.60/MF $0.50

The amplitude-independent dislocation damping of a series of dilute copper–germanium single crystals has been studied as a function of composition and frequency. The measurements have been performed at room temperature on annealed and gamma-irradiated single crystals driven in longitudinal resonance at 80 and 240 kilocycles per second by means of the Marx piezoelectric oscillator. The results indicate that the Granato–Lucke viscous damping analysis cannot account for the observed magnitude and composition dependence of the sampling although the damping is proportional to frequency in agreement with the theory. They further show that a gamma-ray dose of 2×10^8 rads is sufficient to suppress the damping to a composition-independent value of 1×10^{-4} which does not decrease with further irradiation. There is evidence that the total damping consists of a composition-dependent edge dislocation loss superposed on a composition-independent screw dislocation loss. Author (TAB)

N66-23938# Chicago Univ., Ill. Inst. for the Study of Metals.
EXPERIMENTAL INVESTIGATION OF THE ELECTRONIC PROPERTIES OF SOLIDS Final Technical Report

H. Fritzsche Dec. 1965 14 p refs
(Grant AF-AFOSR-148-63)
(AD-629495) CFSTI: HC $1.00/MF $0.50

Research progress is reported in the following fields:(1) Study of the Hall effect in liquid metals and alloys; (2) Study of very impure semiconductors; (3) Optical infrared studies of semiconductors; (4) Investigations of the electronic band structure of solids; (5) The use and development of ultrasonic attentuation techniques. TAB

N66-23959# Ecole Normale Superieure, Paris (France). Laboratoire de Physique.
BAND STRUCTURE AND DISPERSION RELATIONS IN II–VI COMPOUNDS Annual Summary Report No. 2, 1 Oct. 1964–31 Dec. 1965
M. Balkanski 31 Dec. 1965 9 p refs
(Contract AF 61(052)-757)
(ARL-66-0036; AD-629201) CFSTI: HC $1.00/MF $0.50

Efforts have been developed as well in theoretical as in experimental fields, towards the understanding of fundamental processes in the II–VI compounds. Studies on the fundamental electronic transitions are developed through the Faraday rotation, plasma reflectivity and magneto-oscillatory effects, and studies on the lattice dynamics and photon–phonon interaction are developed through group theoretical investigation and far infrared spectrometry. Author

N66-23964# Cornell Univ., Ithaca, N. Y. Dept. of Engineering Physics.
DISLOCATION STRUCTURES IN CLEAVED MAGNESIUM OXIDE
John L. Robins, Robert L. Gerlach, and Thor N. Rhodin 1 Mar. 1966 57 p refs
(Contract Nonr-401(31))
(TR-11; AD-629482) CFSTI: HC $3.00/MF $0.50

Surface structures produced during cleavage of magnesium oxide are described and interpreted in terms of the production and motion of dislocations. The usefulness and applicability of the nucleation decoration technique to obtain high resolution micrographs of surface structures is presented. The observed surface structures are described in terms of production and termination of line pairs associated with the cutting of screw components, the interaction of dislocation half-loops with the surface, and the occurrence of cross-glide and of dislocation multiplication. Author

N66-24104# Stanford Univ., Calif. Microwave Lab.
ENERGY TRANSFER IN SOLID LASER MATERIALS Technical Summary Report No. 6, 1 Aug.–31 Oct. 1965
A. L. Schawlow et al Dec. 1965 6 p ref
(Contract Nonr-225(78); ARPA Order 306-64)
(ML-1393; AD-628076) CFSTI: HC $1.00/MF $0.50

Methods are studied of exciting solid materials for visible, and possibly ultraviolet, maser action; and of energy transfer processes between energy levels and between ions.
Author(TAB)

N66-24506# Joint Publications Research Service, Washington, D. C.
STUDIES IN THE SUPERCONDUCTIVITY OF METALS
1 Apr. 1966 36 p refs Transl. into ENGLISH from Russian
(JPRS-34842; TT-66-31280) CFSTI: $2.00

CONTENTS:

1. MAXIMUM CRITICAL MAGNETIC FIELDS IN SUPERCONDUCTING METALS B. G. Lazarev, Ye. Ye. Semenenko, A. I. Sudovtsov, and V. M. Kuz'menko p 1–9 refs (See N66-24507 13-26)
2. MECHANISMS OF SUPERCONDUCTIVITY V. Z. Kresin p 10–16 refs (See N66-24508 13-26)
3. PULSE METHODS OF INVESTIGATING THE CONDUCTING PROPERTIES OF ALLOYS N. Ye. Alekseyevskiy, A. V. Dubrovin, and V. S. Yegorov p 17–24 ref (See N66-24509 13-26)
4. SUPERCONDUCTIVITY IN THE Ag–Ga SYSTEM N. Ye. Alekseyevskiy p 25–33 refs (See N66-24510 13-26)

N66-24507* Joint Publications Research Service, Washington, D. C.
MAXIMUM CRITICAL MAGNETIC FIELDS IN SUPERCONDUCTING METALS
B. G. Lazarev, Ye. Ye. Semenenko, A. I. Sudovtsov, and V. M. Kuz'menko *In its* Studies in the Superconductivity of Metals 1 Apr. 1966 p 1–9 refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 165, no. 6, 1965 p 1275–1277 (See N66-24506 13-26) CFSTI: $2.00

Critical magnetic field H_k and temperature T_k measurements for indium, tin, and thallium superconductive metallic layers prepared by condensation on a glass backing cooled by liquid helium, are presented. The magnitude of the measurements are linearly associated with the distortions of the crystal lattice and the mean free path of the electrons. The measurements were performed over a wide range of lattice distortions. Graphs of the measurements showing (1) the relationship of H_k to the temperature of an indium metallic layer with thickness of about 5000 Å, (2) the relationship of the critical magnetic field H_o at 0°K to the specific electrical resistance of an indium coating with a thickness of 5000 Å at 4.2°K, (3) the electrical resistance slope dependency upon temperature for an indium coating with thickness of 5000 Å, and (4) the dependency of the change in critical temperature T_k upon the specific electrical resistance at 4.2°K for an indium coating with thickness of 5000 Å, are depicted. The results are discussed. They indicate that metals formed by condensation on a very cold backing possess a maximally distorted crystal lattice; and that the critical magnetic fields obtained for indium and tin are maximal for these metals. L.S.

N66-24508# Joint Publications Research Service, Washington, D. C.
MECHANISMS OF SUPERCONDUCTIVITY
V. Z. Kresin *In its* Studies in the Superconductivity of Metals 1 Apr. 1966 p 10–16 refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 165, no. 5, 1965 p 1059–1061 (See N66-24506 13-26) CFSTI: $2.00

The ionic mass of superconducting metallic crystal films were calculated using quantum mechanics, for studying the mechanism and dependency of the conductivity upon the oscillation of the molecules forming the crystal. Values of ionic mass obtained for experiments in which light metallic atoms were introduced into a lattice structure containing heavy metallic ions (e.g. Hg), agreed with ionic mass values obtained theoretically. L.S.

N66-24509# Joint Publications Research Service, Washington, D. C.
PULSE METHODS OF INVESTIGATING THE SUPERCONDUCTING PROPERTIES OF ALLOYS

N. Ye. Alekseyevskiy, A. V. Dubrovin, and V. S. Yegorov *In its* Studies in the Superconductivity of Metals 1 Apr. 1966 p 17-24 ref Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 165, no. 5, 1965 p 1059-1061 (See N66-24506 13-26) CFSTI: $2.00

Pulse devices used for studying the relationship of the critical current in superconducting alloys to the external magnetic field, are described. The alloys examined were subjected to high magnetic fields created in a solenoid, and to high pulsed current densities. A voltage proportional to the current in the coil, and consequently to the magnetic field as well, was fed to the horizontal plates of an oscillograph; and the magnetic field was read corresponding to specific deviations of the beam with respect to the horizontal plane. The moment that the specimen's superconductivity was destroyed, it was recorded by the appearance of resistance between its potential electrodes. Also described are pulse devices for measuring magnetic fields for specimens with small current densities in pulse fields, and large current densities in stationary fields. It was shown that by changing the current strength and the intensity of the magnetic field, it is possible to obtain relationships of the magnetic field for given materials throughout the entire current range. L.S.

N66-24510# Joint Publications Research Service, Washington, D. C.

SUPERCONDUCTIVITY IN THE Ag-Ga SYSTEM

N. Ye. Alekseyevskiy *In its* Studies in the Superconductivity of Metals 1 Apr. 1966 p 25-33 refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 49, no. 1, Jul. 1965 p 159-162 (See N66-24506 13-26) CFSTI: $2.00

The characteristics of the superconducting properties and phase composition of silver-gallium alloy systems are discussed. Indications are that alloys of the Ag-Ga system containing about 30 at.% Ga pass over to a superconducting state. Pure Ag and Ga were used for preparing the specimen alloys by a smelting process followed by annealing, with Ga concentrations ranging from 5 at% to 98 at%. Magnetic measurements for specimen alloys containing from 20 at% to 70 at% (which were subjected to annealing at temperatures of 220° C to 270° C) were plotted. These alloys gave curves showing a relationship of the magnetic moment to the external field characteristic for semiconductors. Depicted are curves for alloys containing about 35 at% Ga showing the relationships of the magnetic moment to the field, and to temperature. The data are discussed. L.S.

N66-24737# Soreq Research Establishment, Israel Atomic Energy Commission, Yavneh

THE GROUND STATES AND RELATIVE STARK SPLITTINGS OF SOME TRIVALENT RARE EARTH IONS IN THE CUBIC CRYSTAL FIELD OF CALCIUM FLUORIDE

U. Raron May 1964 26 p refs

(Grant AF-AFOSR-63-64)

(IA-897; AFOSR-65-2305; AD-628401) CFSTI: HC $2.60/MF $0.50

The ratios B_4/B_6 of the cubic crystal field parameters are calculated from electron spin resonance on CaF_2:Nd^{3+} and CaF_2: Dy^{3+}, and the results are used to show that the ratio A_4/A_6 is not constant, as required by the point charge model. A linear expression of A_4/A_6 as a function of Z is constructed from the available data. The integrals $\langle r^4 \rangle$ and $\langle r^6 \rangle$ of Freeman and Watson are used in deducing B_4/B_6 for the trivalent rare earth ions. Eigenfunctions and eigenvalues of Lea, Leask and Wolf are employed in deducing the ground states and relative Stark splittings of the rare earth ions. The ground states are: $Pr^{3+}(\Gamma_5)$; $Nd^{3+}(\Gamma_5)$; $Pm^{3+}(\Gamma_1)$; $Tb^{3+}(\Gamma_3)$; $Dy^{3+}(\Gamma_5)$; $Ho^{3+}(\Gamma_3)$; $Er^{3+}(\Gamma_7)$; $Tm^{3+}(\Gamma_2)$; $Yb^{3+}(\Gamma_7)$. Optical spectra are discussed. Author (TAB)

N66-24742# Illinois Univ., Urbana. Materials Research Lab.

MOSSBAUER STUDY OF Co^{57} (Fe^{57}) IN COBALTOUS OXIDE AT HIGH PRESSURE

C. J. Coston, R. Ingalls, and H. G. Krickamer [1965] 11 p refs

(Contracts AT (11-1)-1198); Nonr-1834(05))

(COO-1198-313; AD-627281) CFSTI: HC $1.00/MF $0.50

An account is given of a room temperature study of the Mössbauer effect of Co^{57} (Fe^{57}) in cobaltous oxide up to pressures of about 250 kbar. At atmospheric pressure the Mössbauer spectrum consists of an unsplit line characteristic of divalent Fe^{57} in a paramagnetic, cubic environment. As pressure is applied to the sample, the spectrum unfolds into a hyperfine pattern characteristic of divalent Fe^{57} in a magnetic, noncubic environment. This study is consistent with the fact that the Neel temperature of cobaltous oxide (291° K at atmospheric pressure) increases with pressure. The pressure dependence of the internal magnetic field gradient and isomer shift are discussed. Author (TAB)

N66-24766# New York Univ., N. Y. Dept. of Physics

SOLID STATE RADIATION-INDUCED PHENOMENA Final Report, Mar. 1-Sep. 1965

Hartmut Kallmann Jan. 1966 78 p refs

(Contract DA-36-039-SC-90689)

(AD-628861) CFSTI: HC $3.00/MF $0.75

Various studies relating to solid state radiation-induced phenomena are reported; the relationship between fluorescence, fluorescence quenching, light stimulation, glow areas, and the photo-induced EPR signals in excited Cr and Cu activated ZnS phosphors were studied. Two types of trap levels exist: deep traps due to chromium and shallow traps located in the neighborhood of ionized Cr activators; their trap populations are determined. Alternating current impedance measurements on phto-excited CdS single crystals mounted between insulating layers were carried out. The use of insulating layers eliminates electron and hole injection and allows motion studies of the electrons inside the crystals separately. The transfer of excitation energy in organic solvents was investigated as a function of temperature. Also studied was the charge injection from unexcited inorganic layers into various organic solvents under illumination, and the charge exchange between organic solvents and crystals. C.T.C.

N66-24775# Illinois Univ., Urbana. Dept. of Electrical Engineering.

JUNCTION EFFECTS IN COMPOUND SEMICONDUCTORS Scientific Report No. 3

N. Holonyak, Jr., M. D. Sirkis, C. J. Nuese, and C. M. Wolfe Jun. 1965 47 p refs

(Contract AF 19(628)-4337)

(AFCRL-65-648; AD-629688) CFSTI: HC $4.60/MF $0.50

The report is concerned with the preparation, growth, dislocation structure, and electrical properties of single-crystal GaAsP, both filamentary and ingot size, produced by halide vapor transport. The vapor-liquid-solid (VLS) mechanism is shown to play a dominant role in filamentary growth, while Frank spiral growth patterns are often observed on the growing interface of bulk material. Single-crystal GaAsP ingots are also grown by nucleation on low-index natural faces, and the possibility of a VLS mechanism being operative in the growth

of bulk material is considered. Together with the peculiarities of growth, the phenomenon of crystal habit modification by impurities is observed in the growth of GaAsP for device applications. Since defects in GaAsP may be expected to affect its properties as a semiconductor, the dislocation structure in well-annealed, as-grown ingots is examined and identified by decoration and etching. Dislocation configurations, such as low-angle tilt boundaries, are evaluated and the crystallography of the commonly observed dislocations in bulk material is determined. Finally, the quality and potential of vapor-grown GaAsP as a semiconductor device material are discussed from the standpoint of dislocation structure, measured mobility and carrier densities, and present limitations of the growth process. TAB

N66-24795# Israel Inst. of Tech., Haifa.
ELECTRICAL PROPERTIES OF TRANSITION METAL OXIDES UP TO 1800° C Interim Scientific Report No. 1, 1 Aug. 1964–30 Sep. 1965
D. S. Tannhauser 11 Nov. 1965 73 p refs
(Contract AF 61(052)-825)
(AD-628321) CFSTI: HC $3.00/MF $0.75

Electrical conductivity, thermoelectric power and deviation from stoichiometry of CoO was measured in the range 1000–1450° C. The results are discussed in terms of defect concentrations, ionization energies and charge carrier mobility. Similar measurements on MnO are in progress and are reported in a provisional form. The phase diagram of both materials is a by-product of this work and is reported.
Author (TAB)

N66-24809# Pennsylvania Univ., Philadelphia.
OPTICAL AND MICROWAVE SPECTROSCOPY OF SOLIDS Semiannual Status Report, 1 Jul.–31 Dec. 1965
E. Burstein [1965] 8 p
(Contract Nonr-551(51))
(AD-626748) CFSTI: HC $1.00/MF $0.50

Contents: lattice dynamics, free carrier optical phenomena, tellurium. TAB

N66-24814# Naval Research Lab., Washington, D. C.
DETECTOR INVESTIGATION FOR 8–15 AND 100–4000 MICRON REGIONS Semiannual Technical Summary 1 Jul.–31 Dec. 1965
R. F. Wallis and H. Shenker Feb. 1966 31 p refs *Its* Rept.-18
(NRL-MR-1673; AD-628870) CFSTI: HC $3.60/MF $0.50

The physical properties and performance of germanium and indium antimonide detectors for specific wavelengths are discussed as part of a continuing study. The behavior of deep-lying impurities in germanium was studied in regard to the doped germanium detector. Absorption of radiation by InSb in high magnetic fields was investigated, along with the photoconductivity and transmission properties to observe the ground and excited states of the donor impurities. The thermal characteristics of the electron atmosphere were analyzed on the long wavelength InSb detectors. Efforts were made to obtain purer InSb by modifying the growth apparatus, and gallium-doped germanium samples were prepared to study their optical properties. Detector performance graphs are appended.
E.A.O.

N66-24903# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
THE USE OF OPTICAL METHODS IN STUDIES OF RADIATION DAMAGE IN LOW TEMPERATURE ELECTRON IRRADIATED GERMANIUM [ZASTOSOWANIE METOD OPTYCZNYCH W BADANIU DEFEKTOW SIECI KRYSTALICZNEJ GERMANU NAPROMIENIOWANEGO ELEKTRONAMI W NISKIEJ TEMPERATURZE]
P. Baruch (Ecole Normale Superieure) and J. Piekoszewski Oct. 1965 24 p refs
(INR-657/II/PL) CFSTI: HC $1.00/MF $0.50

Preliminary experiments of 1.7 MeV electron irradiation of n-type germanium samples at 15°K were carried out. The irradiation was performed both in darkness and with an infrared illumination of the samples. In both cases the changes of resistivity and the absorption spectrum in the range of 2.5μ–15μ was measured. The results seem to show the dependence of the efficiency of defects creation on the electron occupation of defects. Author

N66-24956*# Stanford Univ., Calif. Solid-State Electronics Labs.
FUNDAMENTAL STUDIES OF THE METALLURGICAL, ELECTRICAL, AND OPTICAL PROPERTIES OF GALLIUM PHOSPHIDE Quarterly Progress Report, 1 Jan.–31 Mar. 1966
[1966] 22 p refs
(Grant NsG-555)
(NASA-CR-74765) CFSTI: HC $1.00/MF $0.50 CSCL 20L

This report summarizes progress made during this period on studies of the chemical, electrical, and optical properties of cobalt as an impurity in gallium phosphide; the semiconducting properties of gallium phosphide; and the properties of rectifying junctions in gallium phosphide and $GaAs_xP_{1-x}$.
R.N.A.

N66-24959*# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Nuclear Engineering and Science.
RADIATION DAMAGE TO SEMICONDUCTORS BY HIGH-ENERGY ELECTRON AND PROTON RADIATION Progress Report, 15 Sep. 1965–15 Mar. 1966
John C. Corelli et al [1966] 33 p refs
(Grant NsG-290)
(NASA-CR-74734) CFSTI: HC $2.00/MF $0.50 CSCL 20L

Progress is summarized in a study of the 1.8, 3.3, and 3.9μ radiation induced defect bands in silicon; investigations of defects induced in 6 MeV to 88 MeV electron-irradiated n-type germanium; studies of the effect of phosphorus concentration on the radiation-induced 1.8μ band in silicon; and photoconductivity studies in $\approx$45 MeV electron irradiated silicon. Infrared spectroscopy was used to identify the 1.8, 3.3, and 3.9μ defect absorption bands in silicon as being due to the devacancy defect. The silicon samples were oriented and irradiated either with 45 MEV electrons or fast neutrons. Radiation damage induced in n-type germanium was studied by means of electrical properties and carrier lifetime measurements. A comparison of arsenic and antimony-doped samples was made to check the effect of the impurity type and concentration. The effect of phosphorus and arsenic concentration on the production and annealing of the divacancy defect, as detected by the 1.8μ radiation-induced band, was found to be important. Results on the use of a vacuum infrared monochromator for photoconductivity studies are given; and the high resolution of the instrument and the apparent lack of water vapor or CO_2 background absorption in the photoconductivity spectrum were demonstrated. C.T.C

N66-25000*# North Carolina State Coll., Raleigh. Semiconductor Device Lab.
THEORETICAL AND EXPERIMENTAL STUDIES OF RADIATION-INDUCED DAMAGE TO SEMICONDUCTOR SURFACES AND THE EFFECTS OF THIS DAMAGE ON SEMICONDUCTOR DEVICE PERFORMANCE Semiannual Progress Report No. 4, 1 Sep. 1965–28 Feb. 1966
[1966] 44 p refs
(Grant NsG-588)
(NASA-CR-74733; SDL-4-588-1) CFSTI: HC $2.00/MF $0.50 CSCL 20L

Accomplishments are presented in related projects dealing with surface recombination velocity investigations, surface studies of metal oxide semiconductor capacitors, the measurement of surface recombination velocity as a function of surface potential, and deep lying centers in germanium. Relative to the surface recombination investigations, emphasis is placed on determining the effects of Co^{60} gamma irradiation (approximately 1.3 MeV) on both the bulk and surface properties of silicon. In the surface studies, progress is reported in examining silicon surface state density changes induced by gamma radiation. The surface potential area presents experimental determinations of the effects of surface potential on the surface recombination velocity of an oxide-silicon surface and its variation with gamma radiation. The studies concerned with deep lying centers in germanium emphasize both theoretical and experimental lifetime variation effects in diodes. C.T.C.

N66-25036# Tokyo Univ. (Japan). Inst. for Solid State Physics.
ON FERROMAGNETISM IN A SUPERCONDUCTING ALLOY
Toshio Tsuzuki (Kyoto Univ.) Oct. 1965 26 p refs submitted for publication *Its* Ser. A, no. 175
(NP-15817)

Taking into account spin–orbit interaction, it is shown that ferromagnetism and superconductivity can coexist in an alloy containing paramagnetic impurities. NSA

N66-25178 Library of Congress, Washington, D. C. Aerospace Technology Div.
MATERIALS FOR HIGH-TEMPERATURE ENERGY CONVERTERS, ANNOTATED BIBLIOGRAPHY Surveys of Soviet Scientific and Technical Literature
Michael Slesarenko 25 Feb. 1966 45 p refs
(ATD-66-20)

This annotated bibliography was compiled from Soviet open sources published 1960–1965. The 68 entries are arranged alphabetically by first author only. An author index is provided at the end of the report for the convenience of the user. Pertinent information covered includes the following: solid solution, phase diagram, radioisotope thermoelectric generator, single crystal, pn junction, discharge plasma, transition metal, magnetic field, plasma device, binary nickel-base solid solution, indium antimonide, tellurides, arsenides, anodes, thermionic cathodes, tungsten-hafnium system, electron analogue of indium arsenide, niobium-doped rutile, germanium telluride valence-band structure, thin semiconducting films, manganese-silicon alloys, uranium and zirconium carbides, physico-chemical properties of tungsten-rhenium thermoelectrodes, refractory nitrides, manganese selenide, lanthanum and cerium sulfides, aluminum antimonide, thermionic energy converters, thermionic diode, silicides, binary cobalt-base solid solutions, plasma thermoelectric element, iridium effect on palladium, lithium effect on recombination in n-type silicon, autothermionic cathodes. Author

N66-25230# Pratt and Whitney Aircraft, Middletown, Conn.
THERMAL CONDUCTIVITY AND ELECTRICAL RESISTIVITY OF URANIUM MONONITRIDE
B. A. Hayes and M. A. De Crescente Oct. 1965 26 p refs
(Contract AT(30-1)-2789)
(PWAC-481) CFSTI: HC $1.00/MF $0.50

The thermal conductivity of uranium mononitride, measured in the temperature range 900° to 1650°C, was quite temperature dependent below 1200°C. However, it was relatively temperature independent above 1200°C. At 1650°C the thermal conductivity was 0.26 watts/cm-C. The electronic heat conduction was estimated from electrical resistivity measurements and the Weidemann–Franz relationship. Thermal and electrical properties of UN were compared with those of UC. Author (NSA)

N66-25272# Rensselaer Polytechnic Inst., Troy, N. Y.
PREPARATION AND PROPERTIES OF CRYSTALLINE AND GLASSY VANADIUM PENTOXIDE
T. N. Kennedy, R. Hakim, and J. D. Mackenzie Mar. 1966 20 p refs
(Contract Nonr-591(21))
(TR-1; AD-630013) CFSTI: HC $1.00/MF $0.50

A special technique was developed for the preparation of single crystals of vanadium pentoxide having dimensions of 5 cm×5 cm×0.5 cm. Glassy films of V_2O_5 were also prepared by vapor deposition. The expansion coefficient, density and electrical resistivity of these phases were measured. Author (TAB)

N66-25373*# Harshaw Chemical Co., Cleveland, Ohio.
DEVELOPMENT OF OPTICAL COATINGS FOR CdS THIN FILM SOLAR CELLS Final Report
J. C. Schaefer and E. R. Hill Dec. 1965 63 p refs
(Contract NAS3-6464)
(NASA-CR-54965) CFSTI: HC $3.00/MF $0.75 CSCL 20L

Suitable materials were chosen for deposition in film form onto CdS solar cells. The criteria included infrared optical properties, and chemical and mechanical stability. The materials selected were $CaCO_3$, Al_2O_3, SiO_2 and MgF_2. Sputtering and thermal evaporation were investigated as means for deposition of the films. Sputtering was found to be too delicate and too slow to be feasible as a production process. MgF_2 and SiO were thermally evaporated and the resulting films analyzed. Measurements were made of emittance of the CdS cell both bare and with various coatings. Cells with various coatings were stored in a humid environment and performance measured. The combination of 1/3 micron of SiO_x overlayed with 3 to 10 microns of MgF_2 appeared most promising. Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N66-24353# Rocket Propulsion Establishment, Westcott (England).
FURTHER DEVELOPMENT OF STABILITY GRADING OF SOLID PROPELLANTS BY THE OSCILLATORY STRAND BURNER TEST

J. Diederichsen *In* APL Proc. of the 4th Meeting, Tech. Panel on Solid Propellant Combustion Instability Apr. 1964 p 56–57 (See N66-24346 13-33) CFSTI: HC $4.00/MF $0.75

Several problem areas concerned with a method of stability grading of solid propellants by using and oscillatory strand burner test were investigated, and resolutions of these problems are given. It was shown that for premixed gas flames of variable burning velocity that the square root of the light output per unit area of flame is proportional to the mass rate of reaction per unit area of flame. There is still doubt as to whether this also applies to solid propellant combustion. Studies of flame spectra indicate that the fractional amplitude of the light output increases toward shorter wavelengths of light. The fractional amplitude apparently increases when less light from the burnt gas is seen. Under the conditions of an experiment in which the position of the propellant was not sufficiently well defined with respect to the pressure antinode, the effect of velocity oscillations were shown to be unexpectedly large. Thus it is indicated that even a small shift of the position of the pressure antinode during burning of the propellant must be avoided. In addition acoustic response measurements are reported. L.S.

N66-24358# Stanford Research Inst., Menlo Park, Calif.
BULK COMPRESSIBILITY OF SOLID PROPELLANTS
Thor L. Smith and James R. Smith *In* APL Proc. of the 4th Meeting, Tech. Panel on Solid Propellant Combustion Instability Apr. 1964 p 87–90 refs (See N66-24346 13-33) CFSTI: HC $4.00/MF $0.75
(Contract NOw-61-1037-d)

Bulk compressibility data curves for several polyurethane propellant compositions containing either 70% or 80% solids, and for a binder are depicted. The data on the propellants were analyzed in terms of $B_T = B_i V_i$ where B_i and V_i are the compressibility and volume fraction, respectively of the i^{th} component. From the determined compressibilities of the propellants, assumed values for ammonium perchlorate and aluminum, and the volume fractions of the binder, ammonium perchlorate, and aluminum, the compressibility of the binder B_i was computed. The experimental data for the binder in both propellants are in excellent agreement with theoretical calculations. L.S.

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N66-24355# Sheffield Univ. (England).
WORK AT SUMMERFIELD RESEARCH STATION AND THE UNIVERSITY OF SHEFFIELD, ENGLAND
G. F. P. Trubridge and G. Sotter *In* APL Proc. of the 4th Meeting, Tech. Panel on Solid Propellant Combustion Instability Apr. 1964 p 65–74 refs (See N66-24346 13-33) CFSTI: HC $4.00/MF $0.75

Vortex formation in axially peforated solid propellant charges, and combustion zone kinetics studies are reported. Films were made of the burning of six-inch slotted radial burning charges photographed by high speed cameras through the transparent end of a motor window. The effect of a cruciform resonance rod on the flow pattern was investigated. One film shows the incipient formation of vortices in the motor with a cruciform rod suspended from the nozzle end of the motor so that the head end of the rod is slightly off center. Another film of the motor with a shortened rod which does not come up to the head end of the motor, shows the pattern of standing transverse modes at that end. Both firings gave stable pressure records using normal low frequency instrumentation. In addition, literature searches were conducted for theoretical and experimental investigations of solid propellant combustion instability, with the aim of arriving at a proper appreciation of the numerous lines of attack on the problem so the practical design principles for solid propellant rocket motors could be derived. Thus far nothing of quantitative value was found that ensures that instability will not occur in any particular design. L.S.

N66-24356# Canadian Armament Research and Development Establishment, Valcartier (Quebec).
THE INFLUENCE OF AXIAL COMBUSTION INSTABILITY ON THE DEVELOPMENT OF A 23KS20000 MOTOR
F. Jackson, W. G. Brownlee, and A. K. Roberts *In* APL Proc. of the 4th Meeting, Tech. Panel on Solid Propellant Combustion Instability Apr. 1964 p 77–82 refs (See N66-24346 13-33) CFSTI: HC $4.00/MF $0.75

The finite wave axial combustion instability of aluminized ammonium perchlorate/polyurethane (Cardeplex) propellants were ballistically tested with a 17-inch diameter, 180-inch long 23KS20000 solid propellant rocket motor. Summaries of the findings regarding (1) oscillation mode, (2) initiation, (3) burning rate changes, (4) influence of chamber pressure, initial grain temperature, binder level, aluminum level, aluminum type and size, burning rate modifiers, scalers, and motor length, and (5) gross trend for compositional changes are given. These findings were compared with observed trends reported in a double-ended burner. A table of propellant data for various formulations (obtained by addition of 1.8% lithium fluoride) used for other test firings with the motor is presented. L.S.

N66-24381*# Hughes Research Labs., Malibu, Calif. Ion Propulsion Dept.
DEVELOPMENT OF LINEAR-STRIP ION THRUSTORS FOR ATTITUDE CONTROL Summary Report
J. Robert Anderson, Robert Kuberek, and Stephen A. Thompson 13 Jan. 1966 160 p refs
(Contract NAS3-4117)
(NASA-CR-54673) CFSTI: HC $5.00/MF $1.00 CSCL 21C

Single-strip cesium-contact ion thrustors covering the thrust range from 0.1 to 1.0 milipound have been developed. Lifetime of the ion thrustor was demonstrated by several steady-state life tests which accumulated over 3000 hours of total thrust time including a successful 2000 hour test at an average thrust level of 0.56 millipound. Diagnosis of observed accelerator electrode erosion gives a projected lifetime of two years as limited by charge exchange ion bombardment. In addition, neutralizers were operated during these steady-state life tests. Specific emission of the filament-type neutralizers was 50 mA/W before start of the test and no deterioration was observed after 2000 hours. Four thruston

were temperature cycled from 40,500 to 85,000 times each with no deterioration of ionizer heater characteristics. The low-mass ionizer was fabricated almost entirely from tungsten materials and was assembled with the aid of electron beam welding techniques. Author

N66-24537*# Aerojet-General Corp., Sacramento, Calif.
260-IN.-DIA MOTOR FEASIBILITY DEMONSTRATION PROGRAM. VOLUME IV: 260-SL MOTOR INTERNAL INSULATION SYSTEM
8 Apr. 1966 212 p refs
(Contract NAS3-6284)
(NASA-CR-54930; FPR-4) CFSTI: HC $6.00/MF $1.25 CSCL 21H

Motors 260-SL-1 and -2 were insulated with Gen-Gard V-44, an acrylonitrile butadiene, asbestos-fiber-filled rubber. The insulation design thicknesses were based on thickness-loss-rate data obtained from motor 100 FW-2 (100-in.-dia motor) and a 2.0 safety factor. The insulation components were laid up on a mandrel and cured in an autoclave; the cured components were then secondarily bonded into the chamber with an epoxy adhesive. The insulation for subscale motors (44- and 120-in.-dia motors) was designed, fabricated, and installed exactly as proposed for the 260-SL motors, so that any potential problem areas could be discovered prior to processing the first 260-SL motor. The insulation performed satisfactorily in subscale motors, and only minor design and process changes were required before the first 260-SL motor was insulated. Motors 260-SL-1 and -2 were successfully fired on 25 September 1965 and 23 February 1966, respectively; the insulation performance met program requirements. The results of the test firing showed that the methods used to design, fabricate, and install the insulation system in the 260-SL motors were completely satisfactory. Author

N66-24563# Pratt and Whitney Aircraft, East Hartford, Conn.
SUPERSONIC MIXING OF A LIGHT GAS AND AIR
A. Vranos and J. J. Nolan [1964] 43 p refs

Experimental studies have been made of cross flow mixing in a supersonic airstream. Wall static pressure and total pressure and helium concentration profiles were obtained at various axial locations downstream of the injection station. Jet penetration equations are presented which correlate satisfactorily the results of helium and helium-air mixture injections into a Mach 3 airstream. Several different injectors were investigated: discrete sonic jets, circumferential sonic jets, discrete supersonic jets, and a system of four, sonic, circumferentially placed jets. The jet shape, inclination, and size were also varied. Jet penetration is correlated with jet Mach number, density, and velocity, using a simple power law relationship. Penetration was found to be independent of molecular weight and to depend primarily on the ratio of the dynamic head of the jet to that of the airstream. The final correlations show similarities to results obtained from subsonic studies and are in reasonable agreement with recent theoretical work. Mass velocity profiles of injectant are described using an empirically determined spreading coefficient. Author

N66-24587*# Martin Co., Denver, Colo.
ACOUSTIC SCALE-MODEL TESTS OF HIGH-SPEED FLOWS
Final Report
E. B. Smith Mar. 1966 104 p refs
(Contract NAS8-20223)
(NASA-CR-74596; CR-66-13) CFSTI: HC $4.00/MF $0.75 CSCL 21H

The purpose of this contract was to conduct a scale model test program to determine the acoustical field generated by high-chamber-pressure, hydrogen-fueled engines in various cluster configurations. A total of thirteen acoustic measurements were taken during eight program firings. These eight firings were composed of three single-engine firings, three five-engine cluster firings (in the Saturn V configuration) and two eight-engine clusters (one in the Saturn IB configuration and one a circular cluster). The acoustic measurements were divided—four in the near-field and eight in the far-field, to calculate the power spectrum and the far-field characteristics as well as obtain the near-field data. Engine data obtained for each firing include mixture ratio, propellant weight flow, total thrust, and chamber pressure. The acoustic data were analyzed in 1/3-octave bands for study over a frequency range from 50 to 10,000 cps. The power spectrum, acoustic efficiency, and the directivity indices were calculated from the far-field sound pressure level spectra. The near-field decay upstream of the engine exhaust plane and the apparent source location were measured with the near-field data. Results indicate that the cluster configuration does not significantly affect the near- of far-field sound pressure levels. Author

N66-24621*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CHARACTERISTICS OF TWO LARGE-SCALE JET-LIFT PROPULSION SYSTEMS
William H. Tolhurst, Jr. and Mark W. Kelly *In its* Conf. on V/STOL and STOL Aircraft 1966 p 205-228 (See N66-24606 13-02) CFSTI: HC $5.25/MF $2.25

The characteristics of jet-lift VTOL aircraft were investigated in experimental studies of two full-scale configurations having YJ-85 GE-5 turbojet engines as simulated lift engines. One model simulated a supersonic fighter-type airplane and was used to determine the effects of wing and cruise engine inlet position on exhaust gas ingestion during static operation near the ground. The other model represented a wing-mounted lift-engine pod suitable for use on a transport type airplane. This model was used to determine engine inlet pressure recovery and flow distortion, induced aerodynamic effects, and some aspects of lift engine operation during forward flight. The results indicated that the engine inlets may ingest exhaust gases with temperatures of the order of 200°F, and that ingestion of this intensity could cause the engines to stall. By properly locating the inlets with respect to the exhaust nozzles and by taking advantage of the shielding effect of the wing, ingestion was avoided. There did not appear to be any extreme problems in operating the lift engines at free-stream speeds up to 150 knots. These engines operated very well with a simple bell-mouth inlet. Engines located ahead of the wing reduced the overall lift of the aircraft while engines located behind the wing increased the lift. Author

N66-24700# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
TURBOJET ENGINE PROCUREMENT COST ESTIMATING RELATIONSHIPS
Robert Patterson Gould (M.S. Thesis) Aug. 1965 83 p refs
(GSM/SM/65-10; AD-628057) CFSTI: HC $3.00/MF $0.75

Cost estimation is a critical phase of national defense planning, programming, and budgeting. The historical means of accomplishing this in the Air Force is largely qualitative and subjective. Quantitative cost estimation techniques and

some major pitfalls in usage are explored. Despite many assumptions and approximations, cost estimating relationships are felt to offer a sound basis for cost estimation in practice. Turbojet engine costs and major characteristics are determined for fourteen engines, and an effort is made to reveal a basic cost–characteristic relationship. A linear or log-linear relationship is hypothesized. Although theoretical parameters of engine description appear promising, multiple regression of them singly and in combination fail to substantiate cost dependence. A single characteristic, specific weight (dry weight divided by military thrust), accounts for 85 to 92% of cost per unit weight in a log-linear relationship, after four questionable data points are eliminated. TAB

N66-25002*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF ROCKET NOZZLE MATERIALS WITH SEVERAL SOLID PROPELLANTS
James R. Johnston, Robert A. Signorelli, and John C. Freche Washington, NASA, May 1966 36 p refs
(NASA-TN-D-3428) CFSTI: HC $1.00/MF $0.50 CSCL 21H

Rocket nozzle throat insert materials were investigated by using three small-scale solid-propellant rocket engines. The materials used included refractory metals, refractory-metal carbides, graphites, ceramics, cermets, and fiber-reinforced plastics. Three propellants with widely differing flame temperatures and oxidation characteristics were used. The flame temperatures were 4700°, 5600°, and 6400° F. The engines were designed to provide a chamber pressure of 1000 pounds per square inch and a firing duration of 30 seconds with a nozzle throat diameter of 0.289 inch. No one material performed best with all three propellants. Failure by erosion or cracking occurred with each material with at least one propellant. However, certain classes of materials demonstrated superior performance under specific operating conditions. The fully densified refractory-metal nozzles generally were more resistant to erosion and thermal-stress cracking than the other materials. The graphite nozzles performed well with the least oxidizing 5600°F propellant but generally eroded severely with the other propellants. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N66-24283# Belgian Royal Observatory, Uccle.
SOLAR ACTIVITY IN 1964: PHOTOSPHERIC AND CHROMOSPHERIC OBSERVATIONS [L'ACTIVITE SOLAIRE EN 1964. OBSERVATIONS PHOTOSPHERIQUES ET CHROMOSPHERIQUES]
C. Delys and A. Koeckelenbergh 1965 14 p refs In FRENCH *Its* Communications, No. 244
(AR-25, Pt. 1) CFSTI: HC $1.00/MF $0.50

Observations are reported on sunspots by heliographic latitude, daily Wolf number readings, and photographic observations of the photosphere by means of a Zeiss heliograph. Data are also included on the chromosphere and lunar prominences, particularly on solar flares and sudden disappearances of filaments, and number of brilliant surges on the solar disk. A table is given which shows a considerable difference between the number of groups of sunspots in the northern and southern hemispheres; there are 18 northern groups in latitudes above 20 degrees and all southern groups appear between 0 and 15 degrees. The Wolf number of solar activity was observed for values of the k coefficient. Transl. by R. Li

N66-24326*# California Inst. of Tech., Pasadena.
NEUTRINO ASTROPHYSICS; SUPERMASSIVE STARS, QUASARS, AND EXTRAGALACTIC RADIO SOURCES, AND NUCLEAR ENERGY GENERATION IN SUPERMASSIVE STARS
William A. Fowler [1965] 170 p refs Presented at the Intern. School of Phys. "Enrico Fermi", Varenna, Italy, Jul. 1965 (Grant NGR-05-002-028; Contract Nonr-220(47); Grant NSF GP-5391)
(NASA-CR-74447) CFSTI: HC $5.00/MF $1.00 CSCL 03B

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3. SUPERMASSIVE STARS, QUASARS, AND EXTRAGALACTIC RADIO SOURCES, I W. A. Fowler 14 p refs (See N66-24329 13-29)
4. SUPERMASSIVE STARS, QUASARS AND EXTRAGALACTIC RADIO SOURCES, II W. A. Fowler 45 p refs (See N66-24330 13-29)
5. NUCLEAR ENERGY GENERATION IN SUPERMASSIVE STARS W. A. Fowler 21 p refs (See N66-24331 13-29)

N66-24327*# California Inst. of Tech., Pasadena.
NEUTRINO ASTROPHYSICS, I
William A. Fowler *In its* Neutrino Astrophys.; Supermassive Stars, Quasars, and Extragalactic Radio Sources and Nucl. Energy Generation in Supermassive Stars [1965] 27 p refs (See N66-24326 13-29) CFSTI: HC $5.00/MF $1.00

Theoretical contributions to neutrino astrophysics are surveyed, and various observational techniques for neutrino detection are described. Neutrino emission by the sun is considered. The proton–proton (pp) chains are listed to show the main nuclear processes in the sun, and it is pointed out that the neutrinos indicated in the table are associated with electron capture or positron emission. The three main groups of neutrinos emitted in the pp-chain are identified, and measurements of their energies and relative probabilities of emission, made in several nuclear laboratories, are examined. Techniques for detecting solar neutrinos are also assessed, and several experiments are described. It is predicted that continuing research on neutrino astrophysics may soon provide direct information from the center of the sun to serve as a check on current ideas of stellar structure and stellar energy generation. M.G.J.

N66-24328# California Inst. of Tech., Pasadena.
NEUTRINO ASTROPHYSICS, II
William A. Fowler *In its* Neutrino Astrophys.; Supermassive Stars, Quasars, and Extragalactic Radio Sources and Nucl. Energy Generation in Supermassive Stars [1965] 28 p refs (See N66-24326 13-29) CFSTI: HC $5.00/MF $1.00

The suggestion that there is strong circumstantial evidence for the emission of neutrinos and antineutrinos in electron–positron pair annihilation, at just the rate predicted on the basis of the universality of the weak interaction, is reviewed. The theory stems from an analysis of the isotopic abundances in the iron group elements on the basis of nucleosynthesis of these elements in an equilibrium process. It is assumed that solar system iron-group nuclei are typical of nuclei produced in the equilibrium process just outside the imploding central regions of Type II supernovae. Experimental calculations are detailed, and it is shown that a significant connection exists between iron-group abundances and the time scale set by neutrino losses during the stellar stage just prior to core implosion and mantle–envelope explosion. The extent of neutrino and antineutrino emission by various astrophysical sources is assessed, and the results are expressed as the ratio of energy emitted as neutrino or antineutrinos to the rest mass energy equivalent of the emitting system. M.G.J.

N66-24329*# California Inst. of Tech., Pasadena.
SUPERMASSIVE STARS, QUASARS, AND EXTRAGALACTIC RADIO SOURCES, I
William A. Fowler *In its* Neutrino Astrophys.; Supermassive Stars, Quasars, and Extragalactic Radio Sources and Nucl. Energy Generation in Supermassive Stars [1965] 14 p refs (See N66-24326 13-29) CFSTI: HC $5.00/MF $1.00

The optical identification of radio sources is discussed, and methods of determining energy requirements in radio objects are considered. The approach is from the viewpoint that supermassive stars can meet the energy requirements in radio sources, specifically in the quasars. The data show that general relativity leads to dynamic instability in nonrotating massive stars, but the result is relaxation oscillations energized by hydrogen burning rather than catastrophic collapse, at least for masses not exceeding 10^8 $M_\odot$. Emphasis was placed on the observation that the exotic forms of energy emission in the quasars can serve to damp the relaxation oscillations so that stable pulsations results. Based on the findings, the suggestion was made that quasars consist of pulsating supermassive stars, energized by nuclear reactions, with radio and optical emissions from extended surrounding regions which the star excites with ultraviolet radiation and relativistic particles. With the exhaustion of nuclear energy, gravitational energy may become available, and the evolution of a quasar into an extended radio source becomes possible. M.G.J.

N66-24330*# California Inst. of Tech., Pasadena.
SUPERMASSIVE STARS, QUASARS, AND EXTRAGALACTIC RADIO SOURCES, II
William A. Fowler *In its* Neutrino Astrophys.; Supermassive Stars, Quasars, and Extragalactic Radio Sources and Nucl. Energy Generation in Supermassive Stars [1965] 45 p refs (See N66-24326 13-29) CFSTI: HC $5.00/MF $1.00

The results presented constitute an extension of previous material on relaxation oscillations in supermassive stars. It has been shown that a relatively small amount of rotation is sufficient to remove the general relativistic instability which arises in such stars when rotation is absent. The post-Newtonian equations for the binding energy and for the frequency of the fundamental mode of radial oscillations have been derived and close connection between these two quantities has been exhibited. The equatorial instability associated with contraction under rotation has been investigated and the results used to estimate the limiting mass in which hydrogen burning can be effective as a source of energy during relaxation oscillations. For differential rotation this limit is found to be at least 10^8 $M_\odot$ and perhaps as high as 10^9 $M_\odot$ whereas, without rotation, the limit arising from general relativistic considerations is 10^6 $M_\odot$. For uniform rotation the limit is 10^7 $M_\odot$. Author

N66-24331# California Inst. of Tech., Pasadena.
NUCLEAR ENERGY GENERATION IN SUPERMASSIVE STARS
William A. Fowler *In its* Neutrino Astrophys.; Supermassive Stars, Quasars, and Extragalactic Radio Sources and Nucl. Energy Generation in Supermassive Stars [1965] 21 p refs (See N66-24326 13-29) CFSTI: HC $5.00/MF $1.00

An average energy generation per unit mass and per unit time in supermassive stars is established, and energy generation through the CNO bi-cycle using nuclear reaction rate data are analyzed. The central temperature at which the required energy generation is met is also determined. The stability of supermassive stars during hydrogen burning is considered, and the general relativistic instability which arises at very low central temperatures during the early stages of contraction in supermassive stars is introduced. The effects of uniform and differential rotation are discussed, and a comparison is drawn between the limiting temperature for dynamic stability and the required nuclear temperature. It was found that the limiting masses for operation of the CNO bi-cycle under stable conditions are approximately 10^6 $M_\odot$, 10^7 $M_\odot$, and 10^9 $M_\odot$ for no rotation, maximum uniform rotation, and maximum differential rotation, respectively. M.G.J.

N66-24332# Warsaw Univ. (Poland). Dept. of Radiochemistry.
REMARKS ON THE MOTION IN GRAVITATIONAL FIELDS OF EXTENDED MASSES
Bronislaw Kuchowicz Jan. 1966 12 p refs
CFSTI: HC $1.00/MF $0.50

Previous studies are discussed, in which it was proven that for certain values of the physical parameters the neutrinos either do not escape from an incompressible fluid sphere, or may return inside after they have left the sphere for a part of their motion. The possibility that such theories may be applied to neutron stars and quasars, generalized to other gravitational fields, or extended to particles with finite rest mass is discussed. It is also theorized that, assuming various models of the internal structure of gravitating material spheres, various types of trajectories may be obtained for particle motion inside these spheres and crossing their surfaces. M.G.J.

N66-24403*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CORRELATIONS OF MAGNETIC FIELDS AND ENERGETIC ELECTRONS ON THE IMP-1 SATELLITE
K. A. Anderson and N. F. Ness (Calif. Univ., Berkeley) Mar. 1966 87 p refs
(NASA-TM-X-55467; X-612-66-109) CFSTI: HC $3.00/MF $0.75 CSCL 20H

A study of simultaneous magnetic field and energetic particle records from the IMP-1 satellite on the dark side of the earth has shown several distinct correlations which can be understood as diamagnetic effects of charged particle populations. Depression of the magnetic field in the closed magnetic field line configuration of the particle cusp region is observed on most orbits. Attributing this depression to the diamagnetic effects of particles, about 1% of the effect can be attributed to electrons >45 keV. In the geomagnetic tail

region, large depressions of the magnetic field having radial extent ~10 R_e are observed when the satellite approaches the neutral sheet to within ~5 R_e. Finally, there are examples of intense, energetic electron fluxes closely associated with reduction of the magnetic field magnitude. In one case an electron flux of 3×10^6 cm^{-2} sec^{-1} >45 keV was associated with a field change from 20γ to 8γ. Author

N66-24842*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ROCKET MEASUREMENTS OF ENERGETIC ELECTRON PRECIPITATION IN THE AURORAL ZONE
David S. Evans Jan. 1966 33 p refs
(NASA-TM-X-55447; X-611-66-9) CFSTI: HC $2.00/MF $0.50 CSCL 20H

Direct measurements were made of the auroral electron influx in the energy range 2 to 6-keV by particle detectors carried through a diffuse, post-breakup auroral display aboard a rocket launched from Fort Churchill in March 1965. This display was accompanied by both ionospheric absorption of cosmic radio noise and by very strong geomagnetic activity. Electron intensities averaging 3×10^8 electrons (E>25 keV) cm^2/sec/ster and exceeding at times $10^9/cm^2$/sec/ster were encountered during the flight. The electron energy spectra was quite flat, generally being characterized by e-folding energy between 20 and 35 keV but reaching 50 keV at one time. Both the electron flux and the energy spectra exhibited rapid (~0.5 sec) variations on occasion during the flight. The association of the post-breakup aurora, ionospheric absorption, and geomagnetic activity with the observation of large fluxes of precipitated electrons of energies greater than 25 keV form a picture consistent with an intense auroral zone X-ray event. In addition, the overall character of the electron precipitation sampled by this rocket suggests a close association with those electron streams observed by McDiarmid and Burrows on Allouette. Author

N66-24648# Library of Congress, Washington, D. C. Aerospace Technology Div.
TRANSMITTING OF SATELLITE PROPAGATION STUDIES Surveys of Soviet Scientific and Technical Literature
14 Mar. 1966 38 p refs Compilation of Abstracts
(ATD-66-24)

This compilation of abstracts is based on Soviet satellite open sources published 1963–1965. It is the first in a series of reports reviewing Soviet developments in transmitting satellite propagation studies (Cosmos satellite series). Information not directly related to the assigned subject has been included because of its broad implications for study in this field. The 23 abstracts are arranged alphabetically by author. Other data covered in this report: transistorized electrometric amplifier, geoactive particles, electrostatic analyzer, UHF dispersion interferometer, radiometric equipment. There are numerous tables and graphs. Author

N66-24686# Pennsylvania State Univ., University Park. Dept. of Astronomy.
SOLAR RADIO FLUX DURING THE IQSY AT UNIVERSITY PARK, PENNSYLVANIA, JULY–AUGUST–SEPTEMBER, 1965
John P. Hagen Mar. 1966 37 p
(Grant NSF GP-2086)
(SR-003)

This report contains solar radio flux data recorded at 10,700 Mc/s, 2,700 Mc/s and 328 Mc/s during the quarter 1 July 1965 to 30 September 1965. A table of distinct events is also given. Author

N66-24683*# California Univ., La Jolla. Dept. of Physics.
THE SPECTRUM OF CRAB NEBULA X-RAYS TO 120 keV
Laurence E. Peterson, Allan S. Jacobson, and R. M. Pelling 21 Dec. 1965 12 p refs
(Grant NsG-318)
(UCSD-SP-65-5) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Balloon determinations of the Crab Nebula X-ray spectrum over the range of 18 keV to 120 keV were made. The detector used consisted of a NaI crystal 5 mm thick by 24 mm diameter. Collimation was provided by a cylindrical CsI scintillation cup surrounding the detector and its phototube. Data was telemetered event by event in a digital format from a 128 channel pulse height analyzer. Data curves showing (1) the counting rates as a function of time for various energy ranges averaged over 12 minute intervals; and (2) the pulse height distribution of the background, and of the Crab during its transit are given. Also presented is a curve of the incident flux vs energy where corrections were made for atmospheric absorption, deadtime, channel width, and geometric factors. L.S.

N66-24691*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE PRODUCTION OF LOW-ENERGY COSMIC-RAY ELECTRONS
P. B. Abraham, K. A. Brunstein, and T. L. Cline Feb. 1966 75 p refs
(NASA-TM-X-55458; X-611-66-57) CFSTI: HC $3.00/MF $0.75 CSCL 20H

Calculations were made of the intensity of low energy knock-on and beta decay electrons which are secondary to cosmic ray interactions. Interstellar losses due to ionization, leakage from the galaxy, synchrotron, bremsstrahlung, and inverse Compton effects were considered as well as those due to plasma excitations, the red shift, bremsstrahlung, synchrotron, and inverse Compton effects in the intergalactic medium. Energy inputs to the injected secondary electrons by a possible solar electric field of low magnitude, and by a possible galactic Fermi acceleration were investigated. It was shown that one such input is necessary if the observed low energy interplanetary electron intensity is to be attributed to secondary production. Finally, it is pointed out, the observation that the velocity spectrum of electrons in the energy per-unit-mass region of 7 to 25 closely approximates that of cosmic ray protons, and the necessity of constraints on the secondary electron hypothesis, suggest that most of the low energy electrons are of primary origin. D.T.

N66-24789# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
GEOPHYSICS AND SPACE DATA BULLETIN, VOLUM II, NUMBER 3, THIRD QUARTER 1965
Anne L. Carrigan and Norman J. Oliver, ed. 1965 213 p
(AD-629696) CFSTI: HC $6.00/MF $1.25

Contents: Total field intensity magnetometer; Cosmic ray neutron intensity monitor; Oblique backscatter radar; Oblique high-frequency propagation; Riometer; Solar optical patrol observations; Solar radio emission; Vertical incidence ionospheric soundings. TAB

N66-24778# RAND Corp., Santa Monica, Calif.
SCATTERING MATRICES AND RECIPROCITY RELATIONSHIPS FOR VARIOUS REPRESENTATIONS OF THE STATE OF POLARIZATION
Z. Sekera Mar. 1966 49 p refs
(Contract AF 49(638)-1700; Proj. Rand)
(RM-4924-PR; AD-629556) CFSTI: HC $4.60/MF $0.50

This work is a continuation of a study designed to put the theory of scattering and transfer of solar radiation in planetary atmospheres on a rigorous mathematical basis. The work examines several schemes for the complete quantitative description of a stream of radiation with regard to their suitability to the treatment of this theory. Relations between these schemes are found and certain conclusions about their properties are reached. The analytical effort combines classical field-theoretical concepts and optical principles with modern matrix mathematics to make full use of high-speed computers in numerical modeling experiments. Author (TAB)

N66-24819# Universidade Mackenzie, Sao Paulo (Brazil). Grupo de Radio-Astronomia.
A COMBINED REPORT ON GENERAL WORKS AND PRELIMINARY STUDIES ON SOLAR RADIO EMISSION AND SOLAR-TERRESTRIAL RELATIONSHIPS THROUGH V.L.F. PROPAGATION IN THE IONOSPHERE Annual Report No. 2, Sep. 1965-Jan. 1966
Pierre Kaufman Jan. 1966 108 p refs
(Contracts DA-ARO-49-092-65-G76; DA-ARO-49-092-65-G77)
(GRAM-10; AD-628887) CFSTI: HC $4.00/MF $0.75

This is the first annual report on two separate grants, Solar Microwave Radio Emission and VLF Atmospheric Studies. Status and descriptions of the projects, of the Umuarama Radio Observatory, and of the data acquisition system are included. Solar observations on 300 MHz, geomagnetic and geoelectric program as well as plans for measurements at Bage, Brazil during the November 1966 Solar Eclipse are given. Notes and graphs on residual elevation angle vs. altitude, monthly mean solar elevation angles and azimuths, displacement of longitude for a considered sunrise time at several altitudes, along different latitudes are included. Following are also part of the report: (1) Electromagnetic Meaning of Flux Density Measured by Radio Telescope Antennas (2) Results obtained with VLF Atmospherics Measurements (3) Installation of the Geomagnetic Data Monitoring Station. Diagrams, Graphs and Tables illustrate the data collected thus far in the first year of this five-year project. Author (TAB)

N66-24830# RAND Corp., Santa Monica, Calif.
INTERPRETATION OF THE FIRST-ORDER CORRECTION TO THE MAGNETIC MOMENT INVARIANT
R. H. Ball Apr. 1966 9 p refs
(P-3350)

In studying the permanence and stability of the Van Allen radiation belts and in studies of mirror machines, it is important to understand the nature and behavior of the adiabatic invariants of the particle motion. The three possible adiabatic invariants must be found by successive approximations. The first two of these invariants have been calculated beyond the lowest approximation, but the resulting expressions appear too complicated for immediate comprehension of their physical significance. This paper shows that one of these quantities, the first order correction to the magnetic moment M or first adiabatic invariant, has a simple physical interpretation and two simple expressions are given for it. The magnetic moment itself is shown to be conserved to at least first order, a fact that seems to have been obscured by the complexity of the previous derivations of the invariant. R.N.A.

N66-24986*# Yale Univ., New Haven, Conn.
FORMATION OF SOLAR PROMINENCES
P. K. Raju [1966] 93 p refs
(Grants NsG-176-61)
(NASA-CR-74804) CFSTI: HC $3.00/MF $0.75 CSCL 20H

A non-linear treatment of prominence condensation from the corona by means of thermal instability is presented. It is found that the prominence stage is reached after times of the order 10^6 seconds. The major limitations on the process are due to magnetic fields; if the initial field strength is below 10^{-4} gauss, heat conduction by free electrons prevents the formation of condensations. On the other hand, fields above 10^{-1} gauss prohibit a significant density increase. It is suggested that the observed density values develop from secondary processes, after the temperature has reached prominence values as a result of initial thermal instability. Author

N66-25003*# National Aeronautics and Space Administration, Washington, D. C.
SIGNIFICANT ACHIEVEMENTS IN SOLAR PHYSICS, 1958-1964
1966 106 p refs
(NASA-SP-100) GPO: HC $0.50; CFSTI: MF $0.75 CSCL 20H

A summary is presented of significant achievements in solar physics during the period 1958 to 1964. Consideration is given to such areas as instrumentation, mapping the sun's ultraviolet spectrum and soft X-ray spectrum, evidence of solar hard X-ray emission, corona, and satellite monitoring of solar radiation. It is pointed out that measurements of the solar soft X-ray and ultraviolet spectrum have been refined so that the whole spectrum is now known fairly accurately under quiet-sun conditions. Measurements have also demonstrated the large variations in X-ray flux that occur during solar disturbances and the relation between these and ionospheric phenomena. Some unresolved solar problems are briefly discussed, and include thermodynamic structure, geometric structure, velocity fields, flares, coronal phenomena, and solar magnetic fields. C.T.C.

N66-25030# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Atomnoi Energii.
AZIMUTHAL ANGULAR DISTRIBUTION OF SECONDARY PARTICLES IN COSMIC SHOWERS [AZIMUTHAL'NYE UGLOVYE RASPREDELENIYA VTORICHIYKH CHASTITS V KOSMICHESKIKH LIVNYAKH]
A. P. Mishakova and B. A. Nikol'skii 1965 20 p refs In RUSSIAN
(IAE-876)

The azimuthal angular distributions of secondary particles in 169 showers with energies from 10^{10} to 10^{14} ev are studied by the method of paired angular correlations. An isotropic azimuthal angular distribution is observed for the primary showers giving rise to nucleons, and an anisotropic distribution for secondary showers giving rise to pions; this difference points to a different mechanism for the N-N and π-N interactions. Data on the angular correlation of secondary shower particles are explained from the point of view of the fireball model. Author (NSA)

N66-25077# Sandia Corp., Albuquerque, N. Mex.
AIRBORNE PHOTOELECTRIC CORONAL INTENSITY MEASUREMENTS DURING THE MAY 30, 1965 ECLIPSE
M. M. Robertson, M. T. Mattison, and D. H. Liebenberg (Los Alamos Sci. Lab.) 15 Dec. 1965 19 p refs
(Contract AT(29-1)-789)
(SC-DC-65-1826) CFSTI: HC $1.00/MF $0.50

An airborne coronal experiment was conducted during the solar eclipse of May 30, 1965. The experiment was performed to determine, on a relative and absolute basis, the intensities of the radiation of certain coronal spectral lines and chosen band passes of the continuum in the visible spectrum of the corona. These intensities were determined at different discrete line of sight points in the corona and these points were on radii emanating from the sun's center. NSA

N66-25184# Geophysics Corp. of America, Bedford, Mass.
REVIEW OF SOVIET INVESTIGATIONS IN SOLAR PHYSICS
Ali M. Naqvi and Richard E. Berendzen Feb. 1964 182 p refs
(GCA-641)

This work reviews Soviet investigations of the structure of the undisturbed solar atmosphere, including photosphere, chromosphere, and corona; solar activity, including sunspots, faculae, chromospheric flares, and prominences; solar corpuscular radiation; and solar effects on the geomagnetic field and ionosphere. R.N.A.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N66-23986# Lincoln Lab., Mass. Inst. of Tech., Lexington.
GENERATION OF PLANETARY EPHEMERIDES ON AN ELECTRONIC COMPUTER Technical Report No. 391
Michael E. Ash 2 Jun. 1965 86 p refs
(Contract AF 19(628)-500)
(ESD-TDR-65-228; AD-629130) CFSTI: HC $8.60/MF $0.75

A computer program, called the Planetary Ephemeris Program (pep), is being written at Lincoln Laboratory. The purpose of the program is to improve planetary and lunar ephemerides using the results of radar and optical observations. In this report, the author derives the differential equations that are numerically integrated in PEP to determine as functions of time the positions and velocities of the planets, of the earth-moon barycenter and of the moon, and the partial derivatives of these positions and velocities with respect to initial conditions, masses and other parameters. Newtonian theory with the usual unrigorous general relativistic corrections is employed. The equations of motion and the equations for the partial derivatives with respect to initial conditions are presented in the form needed in the Encke's method of integration used in PEP. Author (TAB)

N66-24202# Extraterrestrial Research Center, Ann Arbor, Mich.
APOLLO APPLICATIONS PROGRAM Bibliography
Apr. 1966 618 p Prepared for Gen. Dyn./Convair

An annotated bibliography is presented for experiments related to the Apollo Applications Program. The major portion of the reference material is devoted to earth orbit experiments, and includes reviews of studies dealing with the atmosphere and astronomy, biomedicine and astronaut behavior, communications and navigation, earth sciences and resources, subsystem development, and related physical sciences. Lunar orbit and surface experiments are reviewed; and cover such subjects as electromagnetic sensing, gravity and micrometeorite measurements, and the various scientific disciplines. Also included are a number of general references relating to flights, problems in space, and unmanned probes. M.W.R.

N66-24203# Bendix Corp., South Bend, Ind. Analytical Mechanics Dept.
DOCUMENTATION OF DIGITAL COMPUTER PROGRAMS FOR LUNAR LANDING DYNAMICS—SPECIFIC SYSTEMS ENGINEERING STUDIES
26 May 1965 252 p refs
(MM-65-5)

A computer program is described which permits the simulation of the three dimensional lunar landings with a vehicle having tripodal type legs. The program was generalized to permit the investigation of: a vehicle having cantilever type leg configuration; the effects of a reaction control system using existing reaction control jets on the vehicle; and the effects of a dual level strut stroke versus strut length. In addition the landing dynamics computer program is described. This program has been generalized to permit simulations of planar landings on rough surfaces and to include the effects of a crushable nozzle on vehicle stability investigations. In addition to subroutine flow diagrams and listings, sample runs for checkout purposes are included. These sample runs were performed using single precision on the Univac 1107 computer, however it is stated that these sample runs may be used as an aid to the checkout of the programs on any other digital computer. H.S.W.

N66-24243# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).
A REPRESENTATION OF TRAJECTORY AND VELOCITY COORDINATES FOR SPACE FLIGHT BY A GENERALIZED KEPLER-APPROXIMATION AND CORRECTIONS IN THE ITERATION PROCEDURE [EINE DARSTELLUNG FUR BAHN- UND GESCHWINDIGKEITSKOORDINATEN IN DER RAUMFAHRT DURCH EINE VERALLGEMEINERTE KEPLER-NAHERUNG UND KORREKTUREN IM ITERATIONSVERFAHREN]
W. Bollermann Mar. 1966 59 p refs In GERMAN; ENGLISH summary
(DLR-FB-66-08) CFSTI: HC $3.00/MF $0.50

Superposition of Keplerian movements of a space vehicle around each planet is used to derive an expression which renders the trajectory coordinates highly accurate for limited time intervals. By this method any initial value problem of orbit computation can be solved with the help of perturbation theory. In some standard cases closed approximate solutions for the n-body problem of space flight including additional thrust can be obtained. Auth

N66-24333# Konkoly Observatory, Budapest (Hungary).
PHOTOMETRIC LIGHT—CURVES OF SOUTHERN BV-STARS
E. Schoffel 27 Dec. 1965 23 p refs *Its* Inform. Bull. on Variable Stars No. 118 CFSTI: HC $1.00/MF $0.50

Light curves were derived using sky patrol plates, covering a total time interval of 12,692 days=5479 epochs. The plates were estimated, and the minima and maxima are listed, along with the photometric minima. Figures depicting the data are included. M.G.J.

N66-24366# Joint Publications Research Service, Washington, D. C.
FIGURE AND MOTION OF THE MOON
A. A. Yakovkin, ed. 28 Apr. 1966 157 p refs Transl. into ENGLISH of the book "Figura i Dvizheniye Luna" Kiev, Naukova Publ. House, 1965 p 5–137
(JPRS-35227; TT-66-31664) CFSTI: $4.00

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N66-24367# Joint Publications Research Service, Washington, D. C.
STATUS OF THE PROBLEM OF LUNAR PHYSICAL LIBRATION AND FUTURE DEVELOPMENT IN THIS FIELD
A. A. Yakovkin *In its* Figure and Motion of the Moon 28 Apr. 1966 p 1–4 (See N66-24366 13-30) CFSTI: $4.00

A theory to determine the lunar orbit without error is presented. The coordinates of any point on the visible lunar surface are computed from their relationships to a conversion point obtained by occultation, meridian observation, and limb point photography. Thus, the relief of the limb zone is related to the center of the lunar mass by the physical libration parameters of crater positions, and by recomputation of the conversion point system to a system of barycentric coordinates. G.G.

N66-24368# Joint Publications Research Service, Washington, D. C.
DETERMINATION OF THE CONSTANTS OF LUNAR PHYSICAL LIBRATION BY THE POSITION ANGLES METHOD FROM VISUAL OBSERVATIONS
A. A. Gorynya *In its* Figure and Motion of the Moon 28 Apr. 1966 p 5–22 refs (See N66-24366 13-30) CFSTI: $4.00

A total of 50 refractory observations of position angles of pairs of moon craters were used to determine the parameters of the lunar physical libration. Computed coordinates values for the craters in oblique projection were expressed in fractions of the earth's equator and then used to obtain the theoretical position angles of the crater Moesting A in relation to a limb crater in an eleiptic coordinate system. Measured angles were corrected for the setting of the instrument and for differential refraction. A list of observed craters with their computed observed and theoretical position angles was enclosed. G.G.

N66-24369# Joint Publications Research Service, Washington, D. C.
ON DETERMINING THE CONSTANTS OF LUNAR PHYSICAL LIBRATION
A. A. Gorynya *In its* Figure and Motion of the Moon 28 Apr. 1966 p 23–27 refs (See N66-24366 13-30) CFSTI: $4.00

Analyses of lunar photographs, based on the various position angles of crater pairs, were used to determine the inclination of the lunar equator to the ecliptic and the function of lunar moments of inertia. Computations with the initial value f=0.60 resulted in considerable deviations from the true value of f. The true value of f in any case was greater than the critical value f=0.662. G.G.

N66-24370# Joint Publications Research Service, Washington, D. C.
LIBRATION EFFECT FROM MERIDIAN OBSERVATIONS OF DIAMETERS OF THE MOON AT GREENWICH IN 1900–1954
I. M. Demenko *In its* Figure and Motion of the Moon 28 Apr. 1966 p 28–35 refs (See N66-24366 13-30) CFSTI: $4.00

The libration effect of the lunar radius was obtained from analyses of 266 vertical and horizontal moon diameter observations gathered at Greenwich observatory. Dependency curves of the lunar diameters on optical libration in latitude were used to select the empirical formulas and to compute

their parameters for comparison with theoretical values. Results of processing meridian observations of the vertical diameter showed its dependence on the topocentric libration in latitude; analysis of the horizontal diameter led to the conclusion that the lunar equator is not a circle, and that the lunar disk has an east–west symmetry relative to the central meridian. G.G.

N66-24371# Joint Publications Research Service, Washington, D. C.

SELENOCENTRIC COORDINATES OF 160 BASE POINTS ON THE LUNAR SURFACE

I. V. Gavrilov, A. S. Duma, V. S. Kislyuk, and A. N. Kur'yanova *In its* Figure and Motion of the Moon 28 Apr. 1966 p 36–55 refs (See N66-24366 13-30) CFSTI: $4.00

Sixteen lunar photographs, obtained close to midnight, were measured in order to construct a network of base points with known horizontal and vertical coordinates for a final list of reference craters. Results of these measurements, together with data from the Schrutka–Rechtenstamm catalog, served as basis for a composite space coordinates catalog of 160 base points presented in this study. G.G.

N66-24372# Joint Publications Research Service, Washington, D. C.

A METHOD FOR LUNAR POLYGONOMETRY

I. V. Gavrilov *In its* Figure and Motion of the Moon 28 Apr. 1966 p 56–74 refs (See N66-24366 13-30) CFSTI: $4.00

Point positions on the lunar surface were determined by a coordinate system related to the lunar center of mass. Considered was a system of rectangular selenocentric coordinates whose plane coincided with the plane of the lunar equator, and whose coordinate axes were directed along the axis of rotation and the prime axis, respectively. The position of the coordinate planes of these systems in the body of the moon were then fixed by some number points with known space coordinates obtained from photographs of crater pairs. Compilation of the composite catalog was done by coordinate averaging without their reduction. G.G.

N66-24373# Joint Publications Research Service, Washington, D. C.

DETERMINING THE SELENOGRAPHIC COORDINATES OF POINTS ON THE LUNAR SURFACE AND DISTANCES BETWEEN THEM IN THE PHOTOMETRIC METHOD FOR INVESTIGATING SLOPES

L. R. Lisina and V. V. Shevchenko *In its* Figure and Motion of the Moon 28 Apr. 1966 p 75–86 refs (See N66-24366 13-30) CFSTI: $4.00

A solution to the orientation problem of a lunar negative, and the determination of selenographic coordinates of points and distances for establishing the slopes of lunar surfaces, was found by accurate measurements of rectangular point coordinates on the negative. The mathematical dependence between the true surface of the moon and its plane image as it appeared on the photograph was established by considering an external oblique projection in which the distance D from the center of the projected sphere to the eye point was equal to the topocentric distance from the earth to the moon. With conversion from a sphere to a plane in an orthographic projection, all the circles passing through the center of the projection were represented by straight lines and the angles between them were not distorted. Thus, the distance was determined through the rectangular coordinates of the points with good accuracy. G.G.

N66-24374# Joint Publications Research Service, Washington, D. C.

COMMUNICATION ON COMPUTATION OF THE EPHEMERIS OF MOESTING A

A. A. Yakovkin *In its* Figure and Motion of the Moon 28 Apr. 1966 p 87–92 (See N66-24366 13-30) CFSTI: $4.00

Optical and physical midnight libration data were used to compute the ephemerides of lunar craters in the center region of the moon. Triangulation techniques were used to reduce the entire computation of two formulas expressing the angle at which the arc between the earth and the crater Moesting was visible from the center of the moon, and the position angle of the lunar axis. The topocentric libration was then obtained from the known geocentric libration. G.G.

N66-24375# Joint Publications Research Service, Washington, D. C.

DETERMINING EQUINOX CORRECTIONS FROM LUNAR OBSERVATIONS BY THE NEWCOMB METHOD

D. P. Duma *In its* Figure and Motion of the Moon 28 Apr. 1966 p 93–99 refs (See N66-24366 13-30) CFSTI: $4.00

Equinox corrections from observations of the Sun, Mercury, Venus, and Moon were compared with those obtained from lunar observations by the Newcomb method. It was found that in general corrections based on lunar observations gave a better convergence of individual results than observations of other objects. Discrepancies in five equinox corrections obtained from lunar crater meridian observations were improved by using a uniform distribution of right ascension observations in the Newcomb method of calculations. G.G.

N66-24376# Joint Publications Research Service, Washington, D. C.

INFLUENCE OF THE ERRORS OF LUNAR ORBITAL ELEMENTS ON DETERMINATION OF THE ZERO POINTS OF FUNDAMENTAL CATALOGUES

D. P. Duma *In its* Figure and Motion of the Moon 28 Apr. 1966 p 100–107 refs (See N66-24366 13-30) CFSTI: $4.00

Condition equations for orienting systems of fundamental catalogs from lunar observations were derived by taking into account all the factors exerting any influence on the determination of the equinox corrections and the declination corrections. Discrepancies in the continually changing longitude of the moon in orbit were expressed by correcting the orbital longitude with the mean longitude of the ascending node and the orbital inclinations. G.G.

N66-24377# Joint Publications Research Service, Washington, D. C.

DETERMINATION OF THE EQUINOX CORRECTION FROM OBSERVATIONS OF MOESTING A

D. P. Duma *In its* Figure and Motion of the Moon 28 Apr. 1966 p 108–113 refs (See N66-24366 13-30) CFSTI: $4.00

A series of meridian observations of the lunar crater Moesting A during 1923 to 1954 were analyzed to determine the elements of orientation for a fundamental catalogue. The series covered almost two full revolutions of the lunar nodes; all observations were grouped in hours for right ascension in order to decrease the number of required condition equations. Corrections of Newcomb's equinox, obtained from observations of Moesting A in the variants $-0^s.5 \pm 0^s.006$, $-0^s.098 \pm 0^s$, and $-0^s.097 \pm 0^s.006$ were found too large in absolute value and agreed poorly with existing value as computed from observations of the sun, or large and small planets. G.G.

N66-24378# Joint Publications Research Service, Washington, D. C.

PHOTOELECTRIC RECORDINGS OF LUNAR STAR OCCULTATIONS

V. G. Burachek *In its* Figure and Motion of the Moon 28 Apr. 1966 p 114–116 refs (See N66-24366 13-30) CFSTI: $4.00

An electric photometer, with the photomultiplier mounted on a refractor, was used to observe the lunar occultations of the star 106 Tau ($5^m.3$) and of star 49 B. Cnc ($5^m.9$). Accuracy of the first time determination was about 0.003 sec, and of the second only 0.01 sec due to a comparable bright background. The observed occultation times are presented in a table. G.G.

N66-24379# Joint Publications Research Service, Washington, D.C.

OBSERVATIONS OF THE TOTAL LUNAR ECLIPSE OF 24-25 JUNE 1964 AT THE ASTRONOMICAL OBSERVATORY OF KIEV UNIVERSITY

N. A. Chernega *In its* Figure and Motion of the Moon 28 Apr. 1966 p 117–121 (See N66-24366 13-30) CFSTI: $4.00

Presented are data from the lunar total eclipse observations of June 24 and 25, 1964. Times of the onset of the partial eclipse and the beginning of the total eclipse, of the passage of a shadow through different features on the lunar surface, and of shadows passing across lunar crater centers are shown. The difference between the mean value obtained from observations and the precomputed data for the first shadow was contact $-0^m.3$. G.G.

N66-24380# Joint Publications Research Service, Washington, D. C.

REPORT ON THE SESSIONS OF THE SECOND ALL-UNION CONFERENCE OF THE SUBCOMMISSION OF THE ASTRONOMICAL COUNCIL ACADEMY OF SCIENCES USSR ON THE STUDY OF THE FIGURE AND MOTION OF THE MOON

In its Figure and Motion of the Moon 28 Apr. 1966 p 122–133 (See N66-24366 13-30) CFSTI: $4.00

The following brief reports were presented: (1) *Determination of the Parameters of Lunar Rotation from a Tie-in of a Crater to Stars*—corrections for lunar declinations as caused by the libration effect in radius; (2) *Problems of Selenodesy and Absolute Lunar Hypsometry*—review of principle studies; (3) *Mapping of the Visible Parts of the Moon*—creation of multisheet detailed map; (4) *Optical Probing of the Moon*—recording of reflected signals; (5) *Processing of Stereotelescopic Lunar Photographs*—reliable construction of lunar relief; (6) *Accuracy of the Profile of the Lunar Limb Zone Using Data from Photoelectric Observations*—comparison with corresponding established profiles; and (7) *Results of Several Position Observations of the Moon and Their Use in Astronomy, Geodesy, and Meteorology*. G.G.

N66-24386*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A SIMPLE ATMOSPHERE REENTRY GUIDANCE SCHEME FOR RETURN FROM THE MANNED MARS MISSION

Henry C. Lessing and Robert E. Coate Washington, NASA, May 1966 29 p refs

(NASA-TN-D-3422) CFSTI: HC $2.00/MF $0.50 CSCL 22C

A study was made to determine the capability of a fixed attitude, roll controlled type of lifting body to accomplish the atmosphere reentry at speeds up to 21 km/sec (maximum estimated speed for return from Mars missions) and to develop a guidance scheme requiring only a limited amount of logic and simple calculations for mechanization. The effects of variations of vehicle parameters and atmosphere density on the available corridor depth provided by this type of vehicle were investigated and compared with the accuracy attainable by the midcourse guidance. The results indicate that, at the highest velocity expected for return from the Mars mission, sufficient corridor depth to satisfy midcourse guidance accuracy requirements can be achieved with this type vehicle, provided that atmosphere density information is available prior to reentry and provided also that ground-base tracking data are utilized. It is shown that for this mission and vehicle a simple guidance scheme is capable of satisfying the prime accuracy and acceleration limit constraints on the trajectory. Author

N66-24391*# Melpar, Inc., Falls Church, Va.

ANALYSIS OF THE F-CORONA ACCORDING TO THE MIE THEORY. MATHEMATICAL FORMULATION AND UNIQUENESS OF THE DERIVED THEORETICAL MODELS

R. S. Powell and R. R. Circle Washington, NASA, May 1966 43 p refs

(Contract NASw-1206)

(NASA-CR-469) CFSTI: HC $2.00/MF $0.50 CSCL 03A

A mathematical model is formulated to remove the integrals over scattering angle and particle size which occur in analyzing observations of the zodiacal light. The resulting algebraic equations are expressed in terms of scattering functions with known and easily recognizable properties. Consequently, the uniqueness of deductions concerning the nature of the interplanetary dust can be determined by studying the mathematical behavior of these functions. In addition, the simplified mathematical formulation allows one to judge the relative value of various observations. Single color observations at elongations in the range $20° < \epsilon < 70°$ give unique information concerning the size distribution of the interplanetary dust but not the chemical composition or electron density. Multi-color observations in this range help in determining the electron density but not the chemical composition. Multi-color observations in the range $110° < \epsilon < 180°$ are most valuable in determining the electron density and chemical composition. It is shown that the radial decay constant, α, must be less than 1.5. Author

N66-24396*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

DETERMINATION OF THE SPIN AXIS OF A SPINNING SATELLITE

F. O. Vonbun 3 Jul. 1965 22 p refs

(NASA-TM-X-55452; X-507-66-31) CFSTI: HC $1.00/MF $0.50 CSCL 22A

Many of the satellites sent into orbit during the last few years are spinning for stabilization and or other reasons. The purpose of this paper is to determine the spin axis, a unit vector $\bar{S}^*$, of the satellite using ground tracking information. It will be shown that range rate information is adequate for this purpose. The determination of $\bar{S}^*$ is necessary either to check the onboard sensors once the spacecraft is in orbit or in case of a slight onboard malfunction, the spin axis could not be determined otherwise. Author

N66-24401*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A LUNAR EPHEMERIS, WITH THE EARTH'S EQUATORIAL PLANE AS REFERENCE

Theodore L. Felsentreger Mar. 1966 26 p refs
(NASA-TM-X-55465; X-547-66-94) CFSTI: HC $2.00/MF $0.50 CSCL 03A

Values for the angular orbital elements of the moon and their daily motions, with the earth's equatorial plane as reference, are given at 10-day intervals for a period of five years. In addition, the formulas used in the computations are derived. Results from harmonic analyses of the sine and cosine of the longitude of the node and inclination are also displayed, in addition to graphs which reveal the libratory natures of these two elements. Author

N66-24406# Defence Research Board, Ottawa (Ontario).
THE QUESTION OF THE TECTONIC ORIGIN OF LINEAR FORMATIONS ON MARS
G. N. Katterfel'd Apr. 1966 34 p refs Transl. into ENGLISH from Izv. Vses. Geogr. Obshch. (Moscow), v. 91, no. 3, 1959 p 272–283
(T-445-R) CFSTI: HC $2.00/MF $0.50

An analysis of the photographic and visual maps of Mars was undertaken for the location and number of canals, including double canals. The distribution of the so-called canals, or linear formations, is reported. Data on the lunar and terrestrial tectonic fractures is presented, and the Martian canals were discussed from this viewpoint. The theories on the origin of tectonic faults are considered and tabulated data is given. The nature of oases, and the latitudinal distribution of oases and faults were examined. It was suggested that the main question today is that of endogenic–tectonic versus exogenic–meteoritic origin of Martian oases and of the linear formations connected with them. Among the conclusions are: (1) the canal lineaments have a tectonic origin; (2) the canal lineaments and the oases may be treated as centers of tectonic deformation; (3) the distribution of deformation centers over the surface is determined by pulsation in the shape of the planet; and (4) the overall summary, that the tectonics of the planets are due to nonuniform gravitational compression and nonuniform planetary rotation. N.E.N.

N66-24409# Royal Greenwich Observatory, Herstmonceux (England).
DISCUSSION OF LUNAR OCCULTATIONS OBSERVED IN 1958 AND 1959 (INCLUDING TREATMENT OF OBSERVATIONS FROM 1943)
Flora Mc Bain Sadler London, HMSO, Feb. 1965 17 p refs *Its* Royal Obs. Bull. No. 107 HMSO: 2s

The results of analyses of the lunar occultations observed during 1958 and 1959 are presented and discussed. The observations were reduced using Brown's ephemeris of the Moon and analysed both without and with the application of limb corrections; the observations were also reduced using the Improved Lunar Ephemeris and analysed after the application of limb corrections. The implications of these results and of some minor investigations on the work required on the long series of observations collated since 1943 are discussed: in particular, the decision to re-reduce all these observations using the Improved Lunar Ephemeris. Author

N66-24432*# National Aeronautics and Space Administration, Washington, D. C.
APOLLO EXPERIMENTS GUIDE
15 Jun. 1965 66 p
(NASA-NPC-500-9) GPO: HC $1.00; CFSTI: MF $0.75 CSCL 22A

The NASA guidelines pertinent to experimentation on Apollo space flights are described, and the procedures and requirements for submitting experiment proposals are defined. To acquaint the experiment originator with vehicle capabilities and experiment opportunities, launch vehicle and spacecraft configurations are described. Details are given on the Apollo–Saturn 200 and 500 series development missions, and the Apollo–Saturn 500 series manned lunar landing missions. Typical mission characteristics for both mission series are summarized, and trajectory characteristics are tabulated. Experiment locations are given for the command, service, and lunar excursion modules, and for the Saturn IB and V vehicles. Subsystem capabilities, design considerations, and environmental factors affecting the design of experimental equipment are outlined, as an aid to the potential experimenter in making maximum use of such capabilities. It is pointed out that weight, power, and other provisions must be evaluated for each potential experiment location to determine their combined effect on vehicle performance. M.G.J.

N66-24460# Lincoln Lab., Mass. Inst. of Tech., Lexington.
GENERATION OF THE LUNAR EPHEMERIS ON AN ELECTRONIC COMPUTER Technical Report No. 400
Michael E. Ash 24 Aug. 1965 33 p refs
(Contract AF 19(628)-5167)
(ESD-TDR-65-418; AD-629047) CFSTI: HC $2.00/MF $0.50

This report describes the method of integration that is used in a Lincoln Laboratory computer program (the Planetary Ephemeris Program) to determine as functions of time the position and velocity of the Moon and the partial derivatives of these quantities with respect to initial conditions. The method consists of numerically integrating the differential equations for the differences between the positions, velocities and partial derivatives in the true lunar orbit and in Brown's mean lunar orbit. Author (TAB)

N66-24472# Lockheed Missiles and Space Co., Sunnyvale, Calif.
COME CASES OF PERTURBED MOTION OF A MATERIAL POINT IN A CENTRAL GRAVITATIONAL FIELD
Iu. A. Klikh and N. A. Avramchuk [1965] 9 p refs Transl. into ENGLISH from Dopovidi'akad. Nauk Uk. RSR (Kiev), no. 9, 1965 p 1139–1145

The constant-thrust motion of a space vehicle in a central gravitational field is analyzed solving the differential equations of motion of a variable mass point through power series expansion for the case of constant transverse thrust. The vehicle is considered to be a material point whose mass varies gradually according to the linear law $M=m_0-mt$, where m_0 is the initial value of the mass m, m is the constant mass expenditure, and t is the time. Solutions for radial thrust, and thrust of invariant direction were also obtained. G.G.

N66-24501# Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
ALTITUDE DETERMINATION BY KALMAN FILTERING Third Quarterly Progress Report
James L. Farrell Feb. 1966 48 p refs
(Contract NAS5-9195)
(NASA-CR-74577) CFSTI: HC $2.00/MF $0.50 CSCL 22C

The mathematical background is presented for the dynamic, geometric, and statistical analyses and transformations employed in a study dealing with altitude determination by Kalman

filtering. Straightforward means of describing general angular motion are described in sections on coordinate references, and Euler's geometric and dynamic equations. The precession of angular momentum due to small solar and gravity gradient torques is described; and a restrictive closed form solution is presented for vertically oriented satellites. State variable equations and state transition matrices are adapted to rotational systems for use in the development of the Kalman filtering equations. Sunline and magnetometer measurements are illustrated, along with their allowable ranges of variation. M.W.R.

N66-24514*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

SPACE PROGRAMS SUMMARY NO. 37-38, VOLUME VI FOR THE PERIOD JANUARY 1, 1966 TO FEBRUARY 28, 1966. SPACE EXPLORATION PROGRAMS AND SPACE SCIENCES

31 Mar. 1966 28 p

(Contract NAS7-100)

(NASA-CR-74652; JPL-SPS-37-38, Vol. VI) CFSTI: HC $2.00/MF $0.50 CSCL 22A

The project activities and supporting research and advanced development efforts conducted for some existing space exploration programs are summarized. The testing of various subsystems of the Surveyor spacecraft is discussed and an analysis of spacecraft trouble and failure reports is provided. The progress of the Mariner 1967 project is examined and it is stated that efforts will be made to obtain additional telemetry data from Mariner IV during the second half of 1967 when the spacecraft will again be within the normal communication range of the Deep Space Network. The seven scientific experiments that have been approved for the Mariner Venus 1967 mission are listed. The primary objectives of the Voyager program are reviewed, and the Deep Space Network and its facilities are described. H.S.W.

N66-24551*# Michigan Univ., Ann Arbor. Space Physics Research Lab.

THE LUNAR ATMOSPHERE Scientific Report

F. Hinton and D. R. Taeusch Oct. 1962 90 p refs *Its* Rept.-03555-11-S

(Contract NASw-133)

(NASA-CR-71783; KS-1) CFSTI: HC $3.00/MF $0.75 CSCL 03B

This study was conducted to obtain information about known facts and theories concerning the lunar atmosphere and to postulate a theory of its structure. The limited and observational results to date of measurements of the physical properties of the lunar atmosphere, solar wind, lunar magnetic field, and lunar surface temperature are delineated. The general concepts of the lunar atmosphere are discussed with reference to the mechanisms which affect an exosphere. A simple model of the lunar atmosphere is described. Also described are the experimental measurements to be made by this laboratory, the expected problems, and the meaning of the expected results. This paper is concerned primarily with conditions during quiet sun. R.N.A.

N66-24583*# Vanderbilt Univ., Nashville, Tenn. Dept. of Mathematics.

APPLICATIONS OF CALCULUS OF VARIATIONS TO TRAJECTORY ANALYSIS Final Report

M. G. Boyce and J. L. Linnstaedter Mar. 1966 53 p refs

(Contract NAS8-2619)

(NASA-CR-74611) CFSTI: HC $3.00/MF $0.50 CSCL 22C

This report describes a study on the optimization of multistage rocket trajectories by applying calculus of variations to the trajectory analysis. The classical calculus of variations theory is extended to include control variables. A special multistage fuel minimization trajectory problem is treated in which the lengths of the time intervals of the several stages are known. A simplified example of such a multistage problem is given. The Denbow multistage theory is extended to allow discontinuities in variables and functions at stage boundaries, and further extensions are made to include control variables and inequality and finite equation constraints. The multistage theory is applied to a three stage reentry problem and then to a six stage earth-moon problem for which partial results are obtained. R.N.A.

N66-24589*# Texas Univ., Austin. Engineering Mechanics Research Lab.

FIRST ORDER CONTROL FOR LOW-THRUST INTERPLANETARY VEHICLES

Wallace Thomas Fowler (Ph.D. Thesis) May 1965 156 p refs

(Grant NsG-551)

(NASA-CR-74618; EMRL-TR-1001) CFSTI: HC $5.00/MF $1.00 CSCL 22C

A new control scheme based on the first variation of the calculus of variations and the Weierstrass E-function is presented. It is found that this control scheme is a member of a family of first order control schemes. The new control scheme, E-function control, provides a criterion for choosing the weighting matrix. A numerical comparison of three members of the family of first order control schemes is made. Two of the three control schemes are characterized by arbitrarily chosen constant weighting matrices. The weighting matrix for the third control scheme is chosen in the manner prescribed by the E-function control scheme. A general method of predicting the state of a disturbed system in which not all of the state variables are terminally constrained is introduced. The system model used for the control scheme comparison is a low-thrust vehicle moving along a three-dimensional Earth-Mars trajectory. A reference trajectory is established and then each control scheme is forced to correct numerically introduced state errors. It is found that the new control scheme provides more satisfactory control than either of the other two control schemes. Author

N66-24596*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

EXPERIMENTAL INVESTIGATION OF ULTRA-HIGH VACUUM ADHESION AS RELATED TO THE LUNAR SURFACE Seventh Quarterly Progress Report, 1 Jan.-31 Mar. 1966

J. A. Ryan 26 Jun. 1964 24 p

(Contract NAS7-307)

(NASA-CR-74625) CFSTI: HC $1.00/MF $0.50 CSCL 22A

In studying the ultra high vacuum frictional-adhesional behavior of silicates, data reproducibility for various silicate pairs was determined. Runs were made for hypersthene contacting orthoclase, albite contacting orthoclase, and hornbende contacting bytownite. Silicate-metal runs were also made for aluminum and magnesium alloys, and nickel contacting orthoclase. It was found that general adhesion behavior was reproducible, although some differences in adhesion magnitude were recorded. This difference appears to be due to surface roughness effects. The vacuum system

was modified to permit vacuum cleavage, and two runs involving vacuum cleavage were made. The adhesion forces were found to be large, and a strong long range attractive force was present. It was concluded, tentatively, that the adhesion was caused by normal silicate bonding forces, and long range force was due to surface charging produced by a statistical charge separation during cleavage. A.O.

N66-24605*# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Geo-Astrophysics Section.
CORRELATION OF MECHANICAL AND THERMAL PROPERTIES OF EXTRATERRESTRIAL MATERIALS Second Quarterly Progress Report
J. D. Halajian and J. Reichman Feb. 1966 50 p refs
(Contract NAS8-20084)
(NASA-CR-71750; RM-309) CSCL 03B

In correlating the thermal and mechanical properties of lunar surface materials, mathematical models for surface temperature changes were developed. Two-layer models were analyzed in terms of the thermal intertia constant, and thickness of the layers. It was found that midnight temperatures define these parameters and that, for midnight temperatures above 110°K, the models converge to a homogeneous model for sufficiently large upper layer thicknesses. Using the particulate model, analytical expressions for the solid and radiative components of powder thermal conductivity were developed as a function of porosity, particle size, emissivity, and temperature. The mechanical properties of powders are also discussed with emphasis on the underdense variety. In conclusion, it is stressed that the lunar thermal parameter is far more sensitive to changes of nighttime temperatures than noon temperatures, and that midnight temperature data suggest the lunar surface is not as homogeneous on a km-scale as it appears to be at larger scales. A.O.

N66-24643*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NEAR INFRARED SOLAR ECLIPSE OBSERVATIONS
John Mangus and Ralph Stockhausen Jan. 1966 34 p refs
(NASA-TM-X-55451; X-614-66-29) CFSTI: HC $2.00/MF $0.50 CSCL 03A

This report describes an experiment conceived of as a spectral survey of coronal and chromospheric emission lines in the 1 to 3.5 micron range during the May 1965 solar eclipse. Observational constraints, instrumentation and aircraft mounting, data reduction, spectral contamination, wavenumber calibration, eclipse spectra, time variations, and relative intensities are discussed along with tabulated and graphic results. R.N.A.

N66-24645*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MONOCHROMATIC PICTURES OF THE SUN IN THE Mg II LINE AT 2802.7 Å
Kerstin Fredga Feb. 1966 16 p refs Submitted for Publication
(NASA-TM-X-55455; X-614-66-45) CFSTI: HC $1.00/MF $0.50 CSCL 03A

The filterheliograms of the resonance doublet of singly ionized magnesium were obtained from two Aerobee-Hi rockets. The photographic system, including a Cassegrain–Maksutov telescope, special berefringement filters, and a 35 mm automatic camera, is described. The Mg II pictures were compared with spectroheliograms in Hα and CaK taken approximately at the same time. The plage regions, mottling, and long absorption structures are mentioned. The relative intensities of the different active regions are discussed. It was suggested that the phenomenon is connected with the life history of the active regions, with the smaller areas formed shortly before the photographs were taken, and the larger areas considerably earlier. It is felt that this, together with the height in the chromosphere where the Mg II ions are formed, may give a clue to the formation and development of active regions. N.E.N.

N66-24664*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
RESEARCH IN SPACE SCIENCE. STATISTICAL EVIDENCE OF THE MASSES AND EVOLUTION OF GALAXIES
Thornton L. Page 10 Dec. 1965 44 p refs
(Grant NsG-87)
(NASA-CR-71694; SAO Special Report-195) CFSTI: HC $2.00/MF $0.50 CSCL 03C

Measured velocities in pairs, groups, and clusters of galaxies have been used to estimate average masses. In pairs, these estimates depend strongly on the morphological type of the galaxies involved. In clusters, the measured motions imply much larger average masses, or the existence of intergalactic matter, or instability, and present a serious difficulty in identifying the members of clusters. Other measurable characteristics of galaxies in pairs–their orientations, dimensions, types, and luminosities–are also correlated, suggesting a common origin; but the effects of selection, as pointed out by Neyman, are shown to affect the results. These studies are all related to the problem of evolution of galaxies summarized in a brief resumé. Author

N66-24693*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
VARIATIONS OF THE LUNAR ORBITAL PARAMETERS OF THE APOLLO CSM-MODULE
T. P. Timer Feb. 1966 21 p refs
(NASA-TM-X-55460; X-507-66-60) CFSTI: HC $1.00/MF $0.50 CSCL 20C

This report investigates the variation of the orbital parameters for the forty hour period after insertion into two reference Apollo lunar parking orbits. It is found that while the variation of most of the parameters under the influence of a triaxial moon and other perturbing forces is small, the change in pericynthion height is significant. The amount of change in the various elements during this time is shown. The most pertinent information is with regard to the choice of hypothetical lunar landing sites on the surface of the moon. Choosing a point on the earthward side of the trace which satisfies the constraint that it has a longitude of between 315° and 45° and a latitude of +5° and −5° with respect to a selenographic coordinate system one has a hypothetical landing site. It is found that any subsequent trace of the sub-module point at the same longitude will always lie within 0.5° in latitude of the initial landing site chosen during the forty hours under consideration. Therefore, landing sites chosen in the above manner meet the two requirements as described in Apollo nagivation technical report. Author

N66-24802# Liege Univ. (Belgium). Dept. of Astrophysics.
THE Λ 4300 BAND OF CH IN THE SPECTRUM OF COMET IKEYA (1963a) Technical Note No. 9
C. Arpigny 5 Nov. 1965 22 p refs
(Contract AF 61(052)-587)
(AFCRL-66-111; AD-628813) CFSTI: HC $2.60/MF $0.50

The intensities of the individual rotational lines of the $A^2\Delta - X^2\Pi$ (0, 0) band of CH have been computed by solving the steady-state equations which describes the fluorescence of CH in comets. These intensities are entered in a computer program for producing theoretical profiles

which are then compared with the profile observed in the spectrum of Comet Ikeya (1963a). As in the case of CN it is possible to reproduce the observed intensity distribution when the effects of the Fraunhofer lines are properly taken into account. In order to show this the correct intensity factors appropriate to the $A\,^2\Delta - X\,^2\Pi$ transition of CH have been calculated and are given explicitly. The pure rotation transition probability for the transition from K=2 to K=1 is found to be about 0.01/sec. Author (TAB)

N66-24812# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
NUMERICAL INTEGRATION OF AN ORBIT AND ITS CONCOMITANT VARIATIONS BY RECURRENT POWER SERIES
Andre Deprit and R. V. M. Zahar (Purdue Univ.) Dec. 1965 18 p refs
(D1-82-0501; AD-628934) CFSTI: HC $1.00/MF $0.50

Power series expansions (with coefficients obtained by recurrence formulas) are more efficient than other integration procedures for computing concurrently an orbit and the resolvent matrix of its variational equations, in the Restricted Problem of Three Bodies. For the same requirements on accuracy, the series expansions use only about 30 per cent of the computing time of the multi-step procedures, and only 12 to 15 per cent of the computing time of the Runge–Kutta–Nystrom method. Author (TAB)

N66-24867# Ankara Univ. (Turkey). Dept. of Astronomy.
STUDY OF RADIOELECTRIC RADIATION FROM TWO AREAS OF OUR GALAXY [ETUDE DU RAYONNEMENT RADIOELECTRIQUE DE DEUX REGIONS DE LA GALAXIE]
G. Bourgois, A. N. Eskioglu, I. Kazes, and Nguyen-Quang-Rieu Jun. 1965 18 p refs In FRENCH Publ. de l'Observatoire de Paris, Pt. 27, No. 4
(Rept.-46) CFSTI: HC $1.00/MF $0.50

Curves of equal aerial temperature and positions of maximum radio emission are presented in graph form. Accompanying tables show radio source, position of right ascendant, declination and flux density. The problem of the identification of radio sources detected with optical instrumentation is briefly discussed. Telescopic observations of radio radiation also indicated the complex structure of the Aquila and Cassiopee constellation regions. Transl. by R. Li.

N66-24869# Specola Vaticana (Vatican City).
[REPORTS OF THE ASTRONOMICAL OBSERVATORY AND THE ASTROPHYSICAL LABORATORY] Annual Report, 1965
D. J. K. O'Connell and J. Junkes [1966] 16 p refs
CFSTI: HC $1.00/MF $0.50

This report describes the instrumentation, buildings, Schmidt telescope, photoelectric photometry, computer programming, and some recent observations of the Vatican astronomical observatory. R.N.A.

N66-24881# Observatorium Bosscha, Bandung (Indonesia).
A PHOTOMETRIC STUDY OF THE GALACTIC CLUSTER NGC 6124
Pik-Sin The Repr. from Proc. Bandung Inst. of Tech., Indonesia, v. 3, no. 4, 1965 23 p refs *Its* Contrib. No. 33
CFSTI: HC $1.00/MF $0.50

The galactic cluster NGC 6124 (R.A.=16h18.m8; Dec.=−40°26'; 1950) has been studied by Koelbloed (1959) photoelectrically. Lacking faint stars in his study Koelbloed only made a rough estimate of the distance and age of the cluster. In order to make a more accurate determination of distance and age of the cluster the study by Koelbloed has been extended photoelectrically and photographically to fainter stars. The extension of the photoelectric sequence will also be useful for the study of a nearby T association found by The (1962). It is important to mention that the cluster is seen projected on the edge of a dark cloud, obscuring away faint field stars in the northwestern part of the cluster area. Older distance determinations of this cluster range from 180 to 2100 pcs. Estimates of the cluster diameter range from 2'.5 to 43'. In our photographic study we have measured all the stars down to a limiting apparent magnitude of about V=14.0 magn. lying in a circular area of about 50' diameter. Author

N66-24887# Royal Aircraft Establishment, Farnborough (England).
OPTIMUM IMPULSIVE TRANSFERS BETWEEN NON-COPLANAR ELLIPTIC ORBITS HAVING COLLINEAR MAJOR AXES
H. Hiller Dec. 1965 30 p refs
(RAE-TR-65287) CFSTI: HC $2.00/MF $0.50

The total characteristic velocity was optimized for impulsive transfers between non-coplanar elliptic orbits having a common center of attraction and collinear major axes in the same sense. Up to three apsidal impulses have been considered with the whole plane change occurring at the coincident apocenters of the semi-elliptic Hohmann-type transfer paths. For three-impulse transfers, the optimum mode is to transfer between pericenters of the initial and final elliptic orbits. For two-impulse, i.e., tilted-Hohmann, transfers, the optimum mode is to transfer from the pericenter of the inner ellipse to the apocenter of the outer ellipse; for overlap configurations of initial and final elliptic orbits, optimum transfers from one ellipse to another with larger pericentric distance are from apocenter to pericenter. Author

N66-24889# Royal Aircraft Establishment, Farnborough (England).
THE ORBITAL ELEMENTS OF COSMOS 2 FOR APRIL-JUNE, 1962
R. H. Merson Dec. 1965 24 p refs
(RAE-TR-65284) CFSTI: HC $1.00/MF $0.50

The Orbit improvement program has been used to determine the orbital elements of the satellite COSMOS 2. For the first part of this period field-reduced Baker–Nunn camera observations were used and for the last part optical or visual observations. Author

N66-24891# Royal Aircraft Establishment, Farnborough (England).
REFINEMENT OF ALOUETTE I ORBIT, FOR THE PERIOD 27 APRIL–6 MAY 1964
H. Hiller Jan. 1966 22 p refs
(RAE-TR-66020) CFSTI: HC $1.00/MF $0.50

The orbit of Alouette 1 was computed by N.A.S.A. from observations made by Minitrack stations. For the ten-day period 27 April–6 May 1964, this orbit was refined here, using the same observations, by Merson's differential correction method. A comparison between the refined and N.A.S.A. orbits shows good agreement for semi major axis and right ascension of the ascending node. However, significant discrepancies occur for eccentricity and argument of perigee. Author

N66-24893# Osservatorio Astrofisico Di Arcetri, Florence (Italy).
OBSERVATIONS AND MEMOIRES OF THE ASTROPHYSICAL OBSERVATORY OF ARCETRI, 1964 [OSSERVAZIONI E MEMORIE DELL' OSSERVATORIO ASTROFISICO DI ARCETRI, 1964

[1965] 72 p in ITALIAN /ts Fascicolo No. 80
CFSTI: HC $3.00/MF $0.50

Astrophysical observations of sunspots, solar flares and faculae are given in tables. Data from various observers were compiled daily on solar positions and types and number of sunspots in each group. Spectroheliographs of lunar prominences were made by hydrogen-alpha lines; and spectrograms, with a monochromatic filter. The equipment used in making these observations is described. Transl. by R. Ll.

N66-24900# Crimean Astrophysical Observatory (USSR).
ON THE VARIABILITY OF HD 234677
P. F. Chugainov 27 Feb. 1966 8 p refs Comm. 27 of the I.A.J. Inform. Bull. on Variable Stars No. 122 CFSTI: HC $1.00/MF $0.50

Data on the variable star are reviewed, and the elements of light variation are given. The differences in magnitudes are tabulated for 1954, 1960, and 1965. Explanations for the cause of the periodical variation are discussed. N.E.N.

N66-24907*# National Aeronautics and Space Administration, Washington, D. C.
A PHOTOMETRIC INVESTIGATION OF THE PRESENCE OF OUTER LAYERS OF VOLCANIC ORIGIN ON THE MOON [FOTOMETRICHESKOYE ISSLEDOVANIYE VOPROSA O NALICHII NA LUNE POKROVOV VULKANICHESKOGO PROISKHOZHDENIYA]
V. V. Sharonov May 1966 22 p refs Transl. into ENGLISH from Astron. Zh. (Moscow), v. 42, no. 1, 1965 p 136–144
(NASA-TT-F-9322) CFSTI: HC $1.00/MF $0.50 CSCL 03B

As the mean albedo of the moon is smaller than that of sedimentary and ordinary magma rocks, a photometric study was made of some of the outer layers in the neighborhood of active volcanoes, many of which have a dark color. It was found that the volcanic sands, slags and lapilli, according to their small albedo and to their color characteristics are sufficiently similar to details of the lunar surface. A study of the reflection diagram shows that volcanic ash has a symmetrical diagram and cannot therefore be abundant on the moon. Areas of lapilli and especially flows of block lava, covered by a crust of reticulated slags, have the same type of diagram as the lunar surface. However the elongation is smaller than that for the moon and this indicates a jagged topography. Thus, according to photometric data, there is a similarity between the lunar surface and volcanic layers. The exceptional photometric uniformity of the lunar surface favors the hypothesis that cosmical factors are responsible for lunar surface layer formation. Author

N66-24913*# National Aeronautics and Space Administration, Washington, D. C.
SPECTROPHOTOMETRIC COMPARISON OF MARTIAN CONTINENTS WITH RED-COLORED TERRESTRIAL CAPROCK [SPEKTROFOTOMETRICHESKOYE SRAVNENIYE MATERIKOV MARSA S KRASNOTSVETNYMI ZEMNYMI POKROVAMI]
I. I. Lebedeva Apr. 1966 15 p refs Transl. into ENGLISH from Tr. Astron-Observ., SFR. Mat. (Leningrad), v. 22, no. 39, 1965 p 125–131
(NASA-TT-F-10081) CFSTI: HC $1.00/MF $0.50 CSCL 03A

Relative spectral curves of the integral Martian radiation in the visual region are plotted. The same curves are drawn for the brightness of continents in the center of the disk of the planet, taking into account the optical effect of Martian atmosphere. The curves are compared with the curves of spectral reflectance of red-colored terrestrial rocks. The latter are determined with the SF–2M spectrophotometer. Satisfactory coincidence of these curves may be considered as confirmation of the hypothesis according to which the specific color of the Martian surface is attributed to the presence of a limonite dust. Author

N66-24927*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
CHRONOLOGICAL LISTING OF LUNAR EVENTS
B. M. Middlehurst (Arizona Univ.) and J. M. Burley Apr. 1966 46 p refs
(NASA-TM-X-55470; X-641-66-178) CFSTI: HC $2.00/MF $0.50 CSCL 03A

A complete catalog of observed and recorded lunar events over the past four centuries, i.e., 5 March 1587 to 15 November 1965, is presented, with references. A lunar event is defined as a temporary change in the appearance of a lunar feature, involving a limited area (in most cases, in terms of a few square kilometers) of the lunar surface. D.T.

N66-24932*# National Aeronautics and Space Administration, Washington, D. C.
LUNAR SURFACE STUDIES A Continuing Bibliography, With Indexes
Apr. 1966 70 p
(NASA-SP-7003(02)) CFSTI: HC $1.00/MF $0.75 CSCL 03B

An annotated bibliography is presented with abstracts, and author and subject indexes. Specific topics include the theory of lunar origin, the lunar atmosphere, and the physical characteristics of the lunar surface, e.g., topography, geology, cartography, and stratigraphy. Techniques of lunar observation, measurement, and analysis are covered, along with instrumentation and equipment used in lunar investigations. D.T.

N66-25046*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RANGER VIII AND IX. PART II: EXPERIMENTERS' ANALYSES AND INTERPRETATIONS
Raymond L. Heacock, Gerard P. Kuiper, Eugene M. Shoemaker, Harold C. Urey, and Ewen A. Whitaker 15 Mar. 1966 182 p refs
(Contract NAS7-100)
(NASA-CR-74894; JPL-TR-32-800) CFSTI: HC $5.00/MF $1.25 CSCL 22A

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N66-25047*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

RANGER BLOCK III

Raymond L. Heacock *In its* Ranger VIII and IX. Pt. II: Experimenters' Anal. and Interpretations 15 Mar. 1966 p 7–34 refs (See N66-25046 13-30) CFSTI: HC $5.00/MF $1.25

The contribution of Rangers VII, VIII, and IX to selenography are discussed. Pre-Ranger lunar data obtained by direct and indirect observations and through supporting laboratory studies are reviewed. The three successful Ranger missions are considered to have adequately categorized the small scale topography of a red mare (Mare Cognitum), a blue mare (Mare Tranquillitatis), and highland crater-floor terrain (crater Alphonsus). The use of the digital computer in processing the photographs and also the photographs themselves are discussed. It was concluded that the topography holds no serious hazards for unmanned or manned landings. It was further concluded that the observed topography is the result of primary meteorite and secondary ejecta bombardments. It is apparent that the highland terrain has been extensively modified, and that the highland crater floors and basins are filled with debris possibly to depths of thousands of meters. Evidence for relatively recent or presently existing internal activity is mentioned. N.E.N.

N66-25048*# Arizona Univ., Tucson. Lunar and Planetary Lab.

INTERPRETATION OF THE RANGER RECORDS

Gerard P. Kuiper, Robert G. Strom, and Rudolf S. Le Poole *In* JPL Ranger VIII and IX Pt. II: Experimenters' Anal. and Interpretations 15 Mar. 1966 p 35–248 refs (See N66-25046 13-30) CFSTI: HC $5.00/MF $1.25

The lunar collapse depression, structures of mares and craters, and lineaments are discussed. A study of terrestrial collapse depressions was made to help understand the unexpected lunar collapse depressions. The circularity and the near-vertical orientation of the fracture plane in collapse depression in terrestrial lava fields is mentioned. The structure of Mare Tranquillitatis is discussed with respect to primary and secondary impact craters and circular collapse depressions; square, linear-beaded, and irregular collapse depressions; mare ridges; lineaments; and fine structure. The tentative conclusions on the structure of the crater Alphonsus are reported, concerning the central peak, the dark halo craters and rilles, the crater walls, and the nature of the crater floor. The size–frequency distribution of different classes of lunar craters and their areal densities were investigated. The domical struc- N.E.N.

N66-25049*# Geological Survey, Flagstaff, Ariz.

SIZE AND SPATIAL DISTRIBUTION OF CRATERS ESTIMATED FROM THE RANGER PHOTOGRAPHS

Newell J. Trask *In* JPL Ranger VIII and IX. Pt. II: Experimenters' Anal. and Interpretations 15 Mar. 1966 p 252–263 refs (See N66-25046 13-30) CFSTI: HC $5.00/MF $1.25

The size and spatial distribution of small craters on the moon are discussed, including ray areas on the maria, ray-free parts of the maria, and flat highland basin terrain on the crater floor. Crater distributions from Ranger VII, VIII, and IX photographs were observed to have a tendency for the total crater densities to converge at small crater diameters. A possible steady state size–frequency distribution function for craters of all sizes on the level parts of the moon was estimated. The occurrence of secondary impact craters in significant numbers was interpreted as the principle cause for the rapid increase in the density of crater with diameters between 2 and 6 km. The local differences in crater density in the highlands east of Alphonsus are discussed. Graphs for the cumulative size–frequency distribution of craters are presented. N.E.N.

N66-25050*# Geological Survey, Flagstaff, Ariz.

COHESION OF MATERIAL ON THE LUNAR SURFACE

Henry J. Moore *In* JPL Ranger VIII and IX. Pt. II: Experimenters' Anal. and Interpretations 15 Mar. 1966 p 263–270 refs (See N66-25046 13-30) CFSTI: HC $5.00/MF $1.25

Two lunar crater morphologies are compared, based on Ranger IX photographs. The important features associated with the two craters are: little evidence of blocks on the rims and around the craters; low, lumpy structures on the walls, the rims, and around the craters; asymmetrical rims which are higher and wider on one side than the other; slopes that are less than 45° and probably near 35° or less; and a scalloped rim on one crater. The craters are discussed, and compared with man-made craters on the earth. It was suggested that the lunar surface materials are weakly cohesive to noncohesive. N.E.N.

N66-25051*# Geological Survey, Flagstaff, Ariz.

THE STRUCTURE AND TEXTURE OF THE FLOOR OF ALPHONSUS

Michael H. Carr *In* JPL Ranger VIII and IX. Pt. II: Experimenters' Anal. and Interpretations 15 Mar. 1966 p 270–275 refs (See N66-25046 13-30) CFSTI: HC $5.00/MF $1.25

The textural units, the lineaments and structurally controlled craters on the floor of Alphonsus are discussed. The size–frequency distribution of craters is shown. The distribution of craters larger than 0.3 km was found to differ over the floor, but the density of smaller craters is essentially uniform. Three sets of lineaments were observed to belong to the lunar grid system, and a fourth to be radial to the center of Mare Imbrium. The observable lineaments are reported to be undeflected as they cross topographic features. It is suggested that the alignment of craters along lineaments is strong evidence that many craters were formed by mechanisms originating within the moon. N.E.N.

N66-25052*# Geological Survey, Flagstaff, Ariz.
LUNAR PATTERNED GROUND
Eugene M. Shoemaker *In* JPL Ranger VIII and IX. Pt. II: Experimenters' Anal. and Interpretations 15 Mar. 1966 p 275–284 refs (See N66-25046 13-30) CFSTI: HC $5.00/MF $1.25

The pattern of low ridges and troughs on the lunar surface observed in Ranger photographs is discussed. A tendency was found for the predominant orientations of the linear elements of the lunar patterned ground to be parallel with the larger lineaments. It is suggested that this parallelism indicates that the patterned ground is controlled by underlying structures, which, in turn, are controlled by the regional structural pattern. The patterns are observable in the photographs of Mare Cognitum, Mare Tranquillitatis, and the crater Alphonsus floor. The probable relation of the lunar patterned ground to joints (fractures) and fissures in the underlying surface is discussed. N.E.N.

N66-25053*# Geological Survey, Flagstaff, Ariz.
INVESTIGATION OF THE PHOTOGRAMMETRIC REDUCTION OF THE RANGER IMAGES
James D. Alderman, Warren T. Borgeson, and Sherman S. C. Wu *In* JPL Ranger VIII and IX. Pt. II: Experimenters' Anal. and Interpretations 15 Mar. 1966 p 285–294 refs (See N66-25046 13-30) CFSTI: HC $5.00/MF $1.25

The feasibility of systematic data reduction from Ranger stereoscopic coverage is discussed. The major problems, due to systems limitations, are cited as: the narrow angle lens systems; camera tilt; camera calibration; small base-to-height ratios; image motion and image blur; and video scan lines, image size, scale differences, low sun angle, and lunar photometric effects. These are considered in detail. The advantages of first-order plotters for data reduction are described, but it was felt that time and cost limitations prohibit their modification. Anaglyphic-type plotters were also considered, and the major problems associated with their use are listed. From preliminary test using an anaglyphic projection system, it was concluded that (1) the conditions are environmentally extrinsic to a photogrammetrist, and that (2) the quality of the Ranger images permits considerably more latitude in the model setup than is possible with conventional photographs. An image-blur analysis is included. N.E.N.

N66-25054*# Geological Survey, Flagstaff, Ariz.
EXPERIMENTAL TOPOGRAPHIC MAP OF A SMALL AREA OF THE LUNAR SURFACE FROM THE RANGER VIII PHOTOGRAPHS
Henry J. Moore and Richard V. Lugn *In* JPL Ranger VIII and IX. Pt. II: Experimenters' Anal. and Interpretations 15 Mar. 1966 p 295–302 refs (See N66-25046 13-30) CFSTI: HC $5.00/MF $1.25

The preliminary topographic results from experiments undertaken to study the problems of design of an appropriate anaglyphic projection instrument are presented. The projector system is described, and the problems due to the Ranger VIII stereoscopic camera systems are discussed. It was concluded that the lunar photographs and experimental topographic maps do not conform to terrestrial mapping standards, but that important topographic data are obtainable with the use of photogrammetric techniques. N.E.N.

N66-25055*# Geological Survey, Flagstaff, Ariz.
GEOLOGY FROM A RELATIVELY DISTANT RANGER VIII PHOTOGRAPH
Daniel J. Milton and Don E. Wilhelms *In* JPL Ranger VIII and IX. Pt. II: Experimenters' Anal. and Interpretations 15 Mar. 1966 p 302–313 refs (See N66-25046 13-30) CFSTI: HC $5.00/MF $1.25

Geologic mapping of Mare Tranquillitatis from distant Ranger VIII lunar photographs for classification of mappable units according to relative age, is described. The age and origin of structures and units for each age are discussed. Among the activities in geologic history inferred are: formation of a multiwalled ring structure and smaller craters in pre-Imbrian time; secondary impact cratering by ejections, intermittent volcanism forming plains and dome units, and faulting and filling in the Imbrian Period; formation of small craters, deformation of mare material by faulting, and formation of mare ridges in the Eratosthenian period; and formation of smaller craters, rays, and secondary impact craters, and sliding on steep slopes in the Copernican Period. N.E.N.

N66-25056*# Geological Survey, Flagstaff, Ariz.
INTERMEDIATE-SCALE GEOLOGIC MAP OF A PART OF THE FLOOR OF ALPHONSUS
John F. Mc Cauley *In* JPL Ranger VIII and IX. Pt. II: Experimenters' Anal. and Interpretations 15 Mar. 1966 p 313–319 refs (See N66-25046 13-30) CFSTI: HC $5.00/MF $1.25

The mapping from Ranger IX photographs of Alphonsus, showing the distribution of complex stratigraphic sequence of crater materials and smoother basin floor materials, is presented. Distinctions between the individual geologic units were made on the basis of morphology, slope angles, surface texture, crater density, and relative albedo. The systems and materials for the Imbrian, Eratosthenian, and Copernican Periods are discussed. A reconstructed sequence of events is given, from the original pre-Imbrian crater to the Eratosthenian period. N.E.N.

N66-25057*# Geological Survey, Flagstaff, Ariz.
PRELIMINARY GEOLOGIC MAP OF A SMALL AREA IN MARE TRANQUILLITATIS
Newell J. Trask *In* JPL Ranger VIII and IX. Pt. II: Experimenters' Anal. and Interpretations 15 Mar. 1966 p 319–326 refs (See N66-25046 13-30) CFSTI: HC $5.00/MF $1.25

A preliminary geologic map for a small area in Mare Tranquillitatis covered by Ranger VIII was prepared. Discrimination of mappable units was based principally on albedo and topographic form. The Imbrian, Eratosthenian, and Copernican systems and materials are discussed. The stratigraphic succession in the map indicates that lunar surface materials darken with time. The mare ridges and scarps, and the lineaments are mentioned. The regularity of the lineaments is considered to indicate that they are of internal origin, reflecting a system of fractures or joints in the subsurface. N.E.N.

N66-25058*# Geological Survey, Flagstaff, Ariz.
GEOLOGY OF MARE TRANQUILLITATIS AS SHOWN IN THE HIGH-RESOLUTION RANGER VIII PHOTOGRAPHS
Eugene M. Shoemaker *In* JPL Ranger VIII and IX. Pt. II: Experimenters' Anal. and Interpretations 15 Mar. 1966 p 327–332 refs (See N66-25046 13-30) CFSTI: HC $5.00/MF $1.25

A preliminary morphological classification of Mare Tranquillitatis from the last frames of Ranger VIII is discussed. The high resolution photographs permit a classification of mare craters and depressions and determination of stratigraphic relationships of materials. The morphological categories are: sharp rimmed craters; convex rim craters; funnel craters; dimple craters; low rim craters; and indefinite rim

craters. The mare surface material was assigned to the Imbrian system. The materials of the Eratosthenian and Copernican ages from the various craters and depressions are described. Two types of structural features recognized are (1) a general northwest-tending alignment of indefinite rim craters and depressions, and (2) lineaments in and on the rim of the large low rim crater. N.E.N.

N66-25059*# Geological Survey, Flagstaff, Ariz.
EARLY APOLLO EXPLORATIONS
Eugene M. Shoemaker *In* JPL Ranger VIII and IX. Pt. II: Experimenters' Anal. and Interpretations 15 Mar. 1966 p 332–335 refs (See N66-25046 13-30) CFSTI: HC $5.00/MF $1.25

The scientific mission profiles for an early Apollo exploration on the moon are described. The major goals and fundamental constraints are given. The exploration time, astronaut mobility, and equipment are mentioned. The scientific activities for the three excursions are delineated. N.E.N.

N66-25060*# California Univ., La Jolla.
OBSERVATIONS ON THE RANGER VIII AND IX PICTURES
Harold C. Urey *In* JPL Ranger VIII and IX. Pt. II: Experimenters' Anal. and Interpretations 15 Mar. 1966 p 339–362 refs (See N66-25046 13-30) CFSTI: HC $5.00/MF $1.25

Some physical evidence of lunar surface composition secured by methods other than lunar photography is outlined. Theories on the evolution of the moon and its thermal history are discussed. It is suggested that the moon has had only limited volcanic activity, and that erosion has created the smooth areas. The possibilities of meteorites coming from the moon and of biological material existing on the moon are mentioned. The photographs from Ranger VII, VIII, and IX are analyzed. It is concluded that there is evidence for the following: highly unconsolidated material composing the lunar surface; the presence of slump features; the marked differences in nature as well as appearance between the maria and the mountainous regions; the inhomogeneity of crater wall composition; and the escape of gases from the interior forming the halo craters. N.E.N.

N66-25065*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A STUDY OF THE PROBABILITY OF DEPOSITING VIABLE ORGANISMS ON MARS DURING THE MARINER 1964 MISSION
Norman R. Haynes and Harold J. Gordon 23 Oct. 1964 15 p ref
(Contract NAS7-100)
(NASA-CR-74629; JPL-TM-33-194) CFSTI: HC $1.00/MF $0.50 CSCL 22A

A spacecraft aimed for the close vicinity of the planet Mars cruises through space leaving a trail of particles due to outgassing, firing of the hot motor used for midcourse maneuvers, and activation of the cold gas attitude control system. The ejected particles follow altered trajectories from their point of separation. It is shown that only the spacecraft itself and the attitude control system exhaust contribute significantly to the probability of planet contamination. The Mariner 1964 mission has been designed so that this probability is less than one part in ten thousand. This study considers the actual mission design and assesses the modifications which would be required if the desired probability were to be reduced to three parts in one hundred thousand.
Author

N66-25148# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
IMPROVED DELTA TOS-A REFERENCE TRAJECTORY NO. 2 (ETR LAUNCH)
20 Dec. 1965 94 p refs Attachment to Rept.-A2-130-Delta/AKB1-C341
(A2-260-AAC5-D5683; A2-130-Delta/AKB1-C341)

The reference trajectory for the 750 nautical mile sun-synchronous orbit of the Tiros Operational Satellite-A (TOS-A) is given. The various parameters required for spacecraft launch are reviewed, and the final orbit parameters are provided. It is stated that the radar look angle constraints at second stage engine cutoff are not satisfied by this trajectory, hence, the velocity cutoff system (VCS) will be necessary and will be initiated after approximately 434 seconds of flight. Further analysis indicated that the trajectory would have to be lofted to approximately a 74 nautical mile main engine cutoff altitude in order to satisfy the proposed radar look angles. This would require 0.5% more second stage propellant consumption and the possibility of achieving a second stage command cutoff would drop to 76%. The various optimization techniques that were tried in order to meet the mission requirements without using VCS are discussed and it was concluded that the VCS must be used or reshaping and additional trajectory analysis must be undertaken in order to find a suitable alternative. H.S.W.

N66-25165*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MANUAL ABORT GUIDANCE FROM THE MIDCOURSE REGION OF A LUNAR MISSION
George P. Callas and Robert B. Merrick Washington, NASA. May 1966 42 p refs
(NASA-TN-D-3402) CFSTI: HC $2.00/MF $0.50 CSCL 22C

A manual abort system that incorporates charts for computing the vector abort velocity increment and a simplified Inertial Velocity Measurement Unit (IVMU) for monitoring the abort maneuver has been investigated and simulated on a digital computer. The charts derived from a four-body analysis of the abort problem are based on the concept of preselected abort points along a nominal lunar trajectory. The errors in implementing the abort maneuver are measured with the IVMU and a subsequent vernier velocity correction is made. The principal errors considered are in knowing the vehicle's position and velocity before the abort maneuver and the thrusting errors during the abort and vernier maneuvers. The IVMU measurement errors are assumed to be negligible compared to the thrusting errors. The abort maneuvers are restricted to the original trajectory plane, and the velocity increments are assumed to be impulsive. It is shown that aborts can result in safe returns for emergencies occurring in the region from lunar injection to well within the moon's sphere of influence, and that some degree of landing site control is possible if the emergency does not require a minimum return time. Author

N66-25250*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PHOTOGRAPHIC OBSERVATIONS OF A LOW-DENSITY IRON ARTIFICIAL METEOROID
Gale A. Harvey Washington, NASA, May 1966 28 p refs
(NASA-TN-D-3420) CFSTI: HC $1.00/MF $0.50 CSCL 03B

A shaped charge, boosted to an altitude of 48 kilometers by a single-stage rocket, was used to accelerate 1.5 grams of minute cast-iron particles to a velocity in excess of 10 kilometers per second. The radiation from this artificial meteor was measured with ballistic cameras and modified aerial

cameras using panchromatic film. A light curve was established and a spectrum of the event was analyzed. The first half of the short meteor trail was masked by the explosion of the shaped charge, and, thus, the radiation from the iron dust ball was only measured for that portion of the trail, about 100 meters long, outside the fireball of the explosion. The maximum measured light intensity of the meteor was −0.4 of an absolute meteor magnitude as determined by use of intensity of background stars for calibration. A lower limit of 0.95×10^{-3} was obtained for the luminous efficiency factor for panchromatic film. Calculations indicate that if the low-density iron meteor had been produced at an altitude of 70 kilometers, the intensity would be 3 magnitudes less than at 48 kilometers but still bright enough to be recorded by optical systems similar to those used for natural meteor detection. Author

N66-25282# TRW Systems, Redondo Beach, Calif.
THE SOVIET SPACE PROGRAM: A SELECTIVE BIBLIOGRAPHY Special Literature Survey No. 16
L. R. Magnolia, comp. 9 Mar. 1966 16 p refs
(TRW-9990-7235-TO-000)

An annotated bibliography of selected titles is presented on Soviet space research. Topics include: manned space flight; far side of the moon; ionospheric physics; physiological responses of animals and men to the space environment; various and sundry logs of Soviet space activities; satellite observations of the Soviet high altitude thermonuclear explosion; earth magnetosphere measurements; cosmic radiation; solar physics; Soviet Mars and Venus projects; and earth radiation belts. D.T.

N66-25297# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
A SENSITIVE PHOTOMETRIC LUMINOSITY DISCRIMINANT FOR LATE TYPE DWARF AND GIANT STARS
John S. Neff Dec. 1965 15 p refs
(Grant NSF GP-4976)
(Rept.-65-44)

Filter photometry of late type giants and dwarfs, with intermediate bandpass interference filters located at 0.33μ, 0.37μ, 0.47μ, and 0.55μ, is presented. The locations of of unreddened dwarfs and giants as well as little reddened super-giants on several two-color diagrams are shown. Giants and dwarfs later than G5 on the MK system, with similar $m_{.47} - m_{.55}$ colors, can have ultraviolet colors $m_{.33} - m_{.37}$ that can differ by as much as 0.2 with the giants showing a deficiency relative to the dwarfs. No previous intermediate or broad bandpass photometric system has reported a separation this large. It is suggested that late type dwarfs can be separated from giants by photometric observations of this type. Author

N66-25318# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
A SOLUTION FOR ATMOSPHERIC ENTRY TRAJECTORIES DEVIATING FROM EQUILIBRIUM GLIDE
M. Hanin Apr. 1966 54 p refs
(UTIAS-111) CFSTI: HC $3.00/MF $0.50

An analytical solution is obtained for atmospheric entry trajectories of lifting vehicles at subcircular speeds, constant angles of attack and small initial flight-path angles. The solution represents motions whose initial conditions deviate from those of an equilibrium glide. It is known from previous investigations that these motions are in general oscillatory. In the present study, the equations of motion are linearized about equilibrium glide and then are solved asymptotically in series of descending powers of a large parameter k, where k^2 denotes the ratio of planetary radius to the atmospheric decay length. Explicit expressions are derived for terms of the series up to the order of k^{-2}. Author

N66-25366* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RANGER VII PHOTOGRAPHS OF THE MOON, CAMERAS A, B AND P
1966 478 p refs Prepared for NASA
(NASA-SP-111)
GPO: $6.50 CSCL 22A

Photographs of the moon taken by Ranger VIII are presented. Included are description of the mission, trajectory, impact area selection, camera terminal alignment, and television system. Tables give the following information for each photograph: GMT of frame exposure; spacecraft altitude latitide, and longitude; photograph latitude, longitude, slant range, incidence angle, phase angle, and emission angle; the E–W and N–S scale; and the deviation north. N.E.N.

N66-25371*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
APPARENT LUNAR ACTIVITY: HISTORICAL REVIEW
Jaylee Burley and Barbara M. Middlehurst (Arizona Univ.) Apr. 1966 13 p refs Presented at the NAS Symp. on Surface Features of the Moon, Seattle, 13 Oct. 1965 Submitted for Publication See N66-24927
(NASA-TM-X-55468) CFSTI: HC $1.00/MF $0.50 CSCL 03B

A historical review is presented on more than 200 lunar surface events observed and recorded over the past four centuries, i.e., 5 March 1587 to 15 November 1965. The material was analyzed with respect to (1) solar activity as measured by monthly sunspot numbers, and (2) tidal action by the earth. Based on the frequency distribution, which shows well defined peaks at perigee and apogee, of the sightings around the lunar orbit; it is concluded that the events are due to internal causes which are accelerated near perigee and apogee through tidal disruption. D.T.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N66-24108*# Planning Research Corp., Washington, D. C.
OPERATIONAL RELIABILITY ASSESSMENT OF THE GEOS A SPACECRAFT
Charles E. Bloomquist, Winifred C. Graham, Jerome A. Kolkin, Donald B. Levinson, Robert J. Mulvihill et al 29 Oct. 1965 85 p ref *Its* Tech. Advisement Memo. No. 106-10
(Contract NASw-1180)
(NASA-CR-71923; PRC-D-1056) CFSTI: HC $3.00/MF $0.75 CSCL 22B

The operational reliability of the GEOS A spacecraft was assessed, in order to implement a method of recognizing and diagnosing possible in-orbit failures, and of providing corrective actions for these possible failures. Subsystem failure modes were related to system operation, and it was determined that most of the needed information for diagnosis

was available from telemetry data. The four types of corrective actions possible were itemized. In addition to the subsystem procedures, attention was also focused on the overall manner in which these procedures could be used; one possible method is included. Diagnostic routines and decision-action procedures were prepared for the power supply, thermal control, command, and telemetry subsystems, and optical beacon and associated electronics. The problem of how to proceed when telemetry data is lost is considered, and the application of decision theory to the case of loss of single telemetry channels is presented. Telemetry and command lists are included. M.G.J.

N66-24109*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 6, NO. 5
15 Mar. 1966 29 p
(NASA-TM-X-57362; X-512-66-51) CFSTI: HC $2.00/MF $0.50 CSCL 22B

Tabulated data are presented on orbiting satellites, with information given on the code name, catalog number, source, launch date, period (minutes), inclination, apogee, perigee, and transmitting frequency. Additions to the decayed objects lists are included, along with the date of decay. The initial elements of objects whose launch and orbit decay occurred within the reporting period are also given. M.G.J.

N66-24122*# Lockheed Missiles and Space Co., Palo Alto, Calif.
INVESTIGATION OF IN-FLIGHT ROLL CONTROL TECHNIQUES FOR SOUNDING ROCKETS Final Report, Aug.–Dec. 1965
D. A. Price, E. O. Nelson, and J. E. Torillo 31 Dec. 1965 117 p refs
(Contract NAS5-9628)
(NASA-CR-71930; LMSC-L-31-65-1) CFSTI: HC $4.00/MF $0.75 CSCL 16D

As configurational, mass, and thrust asymmetries cause coupling between the pitch and roll modes, techniques for controlling in-flight roll of sounding rockets were evaluated. Three methods were studied: reaction impulse, aerodynamic surface deflection, and center of gravity shift. Roll lock-in phenomena are reviewed, and the relative merits of each method are assessed on the basis of simplicity, reliability, weight, size, and adaptability to operational and development vehicles. Performance requirements for each technique are delineated, based on a representative and significant improvement in the asymmetry contours. The performance capability for each method was selected for design comparison. Means for maintaining roll control were devised by (1) overpowering the asymmetry effects with auxiliary roll driving moments, and (2) reducing the effects of the asymmetries. It was concluded that significant improvement in the asymmetry tolerance contours for maximum angle of attack and roll lock-in can be obtained with roll and pitch control, with the magnitude of improvement directly proportional to the size of the applied control moment. M.G.J.

N66-24385*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TEMPERATURE CONTROL. A CASE HISTORY OF THE MARINER SPACECRAFT
R. K. Refley 1 Mar. 1965 33 p refs Revision No. 1
(Contract NAS7-100)
(NASA-CR-74020; JPL-TM-33-189) CFSTI: HC $2.00/MF $0.50 CSCL 22B

The logic underlying the thermal design of the Mariner spacecraft is reviewed. The temperature control philosophy is developed showing the influence of mission requirements, spacecraft configuration, and operational constraints on the spacecraft thermal design. Detailed engineering consideration is given to the trade-offs, alternatives, and ramifications of using louver systems, super insulation, and surface coatings. It is concluded that a reasonable thermal design has been conceived and implemented for the Mariner spacecraft. Author

N66-24400*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE EFFECT OF A FIN TRAILING-EDGE WEDGE ON THE ROLL HISTORY OF A NIKE APACHE
Howard L. Galloway, Jr. Feb. 1966 89 p refs
(NASA-TM-X-55463; X-721-66-85) CFSTI: HC $3.00/MF $0.75 CSCL 16D

When roll-time histories of missiles carrying fin wedges revealed an unexpected relationship of roll rate as a function of velocity, a heavyweight fin with trailing-edge wedge was tested for greater aeroload resistance. The fins were thermally protected. The rocket carrying these fins achieved a flight close to the theoretical trajectory. The flight was stable and the resulting roll-rate history was what is now known to be the prescribed roll-rate history. The report includes the method of calculating Apache natural pitching frequency, as well as methods for avoiding pitch-roll lock-in. Author

N66-24431# Royal Aircraft Establishment, Farnborough (England).
THE COMMUNICATIONS SATELLITE, MOLNIYA 1 Current Information on Russian Research and Development
16 Jun. 1965 10 p Transl. into ENGLISH from Pravda (Moscow), 30 May 1965
(RAE-LIB-TRANS-76)

The method of orbital insertion, orbital parameters, physical description, and operation capabilities are given for the Soviet communications satellite, Molniya I. Among the points discussed in the narrative account were: (1) The final orbit was achieved by thrusting from an intermediate low orbit, and is maintained against perturbations and in optimum signaling position by an on-board rocket motor. (2) Satellite positioning relative to the sun is accomplished by a solar battery. (3) Retransmission equipment handles television, telephone, and telegraph communications. (4) Radiation measurements and effects and operating conditions are reported by a telemetry system. (5) Testing has been done for the transmission of color television by the Secam system. E.A.O.

N66-24486*# Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
ARIEL II ENGINEERING DATA ANALYSIS, PHASE I, VOLUME II
23 Jun. 1965 528 p
(Contract NAS5-9104)
(NASA-CR-74540) CFSTI: HC $8.27/MF $2.75 CSCL 22B

Over four hundred graphs of orbital data signalled back from the Ariel II satellite are presented. The graphs depict orbital maximum and minimum positions and various performance parameters. The graphs include plots of temperature vs time; voltage vs time; current vs time; and other special purpose plots. Some of these depict the high and low speed galactic noise; ozone temperatures; upper and lower shelf temperatures; and other spectrometric responses. L.S.

N66-24489*# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
ENGINEERING METHOD TO PREDICT SATURN V VEHICLE JET IMPINGEMENT Quarterly Progress Report No. 3, 1 Jan.–31 Mar. 1965
A. Africano 15 Apr. 1965 53 p refs
(Contract NAS8-11407)
(NASA-CR-74556; SID-65-550) CFSTI: HC $3.00/MF $0.50 CSCL 22D

Experimental data on forces and heat loads induced by rocket jet plume impingement from sea level to near-vacuum environments are compared with theoretical and empirical prediction methods. The configuration of the Saturn V vehicle and launch complex environments is simulated by typical flat and curved surfaces, and an analysis is presented of the geometry of impingement on curved surfaces. Jet plume interaction with freestream is reported, and the influence coefficients for handling small changes in input variables are included. Heat transfer due to jet impingement is discussed, and alternate prediction methods are given which are based on aerodynamic stagnation flow and turbulent flow analyses. The heat transfer rate versus impingement pressure relation is considered, and data are presented on a plume radiation study which includes: (1) estimated radiation during Saturn SA-5 launch, (2) effect of geometrical error in equation for received power, and (3) relationships for radial particle flow. M.W.R.

N66-24495*# Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
ARIEL II ENGINEERING DATA ANALYSIS, PHASE I, VOLUME I
23 Jun. 1965 70 p
(Contract NAS5-9104)
(NASA-CR-74566) CFSTI: HC $3.00/MF $0.75 CSCL 22B

Telemetered data is reduced and plots are prepared for the engineering and experiment performance of the Ariel II international satellite. Graphs are presented to illustrate dynamical performance in terms of spin rate decline, power system performance, and thermal performance. While the available data are considered inadequate for a complete analysis it is felt that they offer possibility for use in hypothesis advancement and analytical plot studies. Data deficiency is attributed to the fact that the post-launch evaluation and its specific goals were not anticipated when the data recordings were made. As a result, the data on the first 10 orbits has too many gaps to provide a good basis for establishing the character of thermal stabilization and indirect methods must be employed to infer spin axis to sunline angle because of the absence of direct measuring sensors on the satellite. The proposal for conducting the Ariel II satellite post-launch evaluation is appended. M.W.R.

N66-24497*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
GRAVITY GRADIENT STABILIZATION SYSTEM FOR THE APPLICATIONS TECHNOLOGY SATELLITE Third Quarterly Progress Report, 1 Jan.–31 Mar. 1965
20 Apr. 1965 393 p *Its* Doc.-65SD4266
(Contract NAS5-9042)
(NASA-CR-74571) CFSTI: HC $7.00/MF $2.00 CSCL 22B

A preliminary flow diagram is presented for the computer program of the Applications Technology Satellite (ATS) mathematical model, and a preliminary orbit test plan is included for the ATS-A flight. In support of the combination passive damper concept, test results are detailed for an evaluation of the diaphragm clutch, measurement of the eddy current damping coefficients, torsional restraint, and diamagnetic repulsion force measurements. Theory and operation of the boom angle detector, which has a digital output and simplified circuitry, are discussed. The electrical configuration and interface for the attitude sensor, as well as a method for simulating the Earth as seen from the TV camera, are included. The effect of orbit parameter uncertainties on the determination of spacecraft attitude is reported, and a TV attitude sensory error analysis is included. Other reports deal with: (1) ATS-A capture studies; (2) response to internal disturbance torques; (3) effects of primary rod extension rate on structural integrity; and (4) analysis of solar aspect sensor electrical, mechanical, and optical errors. M.W.R.

N66-24500*# Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.
ADVANCED SYNCOM. VOLUME 4: SYSTEM AND SUBSYSTEM PERFORMANCE REQUIREMENTS Summary Report
31 Oct. 1963 72 p
(Contract NAS5-2797)
(NASA-CR-74580; SSD-31121R) CFSTI: HC $3.00/MF $0.75 CSCL 22B

System and subsystem performance specifications for the Advanced Syncom satellite are presented both in descriptive and tabulated form. Requirements are given for the spin speed control and resolution; spin stabilization and maintenance; weight; balance; dimensions; vibration; telemetry; loading; thermal environment; communications; command; pressure; nutation; orbit; structure; and other factors entering into the designing of a structural engineering model of Advanced Syncom. A photograph of this model is given, along with a schematic diagram showing the general internal arrangement of the satellite. L.S.

N66-24502*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
GRAVITY GRADIENT STABILIZATION SYSTEM FOR THE ADVANCED TECHNOLOGICAL SATELLITE First Quarterly Report, 29 Jun.–30 Sep. 1964
16 Oct. 1964 217 p refs *Its* Doc.-64SD4361
(Contract NAS5-9042)
(NASA-CR-74573) CFSTI: HC $6.00/MF $1.25 CSCL 22B

Systems development and analysis, a preliminary definition of the orbit test plan, and details of the orbit test simulation exercise are presented for the gravity gradient stabilization system for the advanced Applications Technology Satellite (ATS). Coordinate frames required to derive the mathematical model are presented. Factors which influence the design concept selection of the boom subsystem are included, and test activities on the boom subsystem are detailed. Progress is reported for the three critical interface areas: spacecraft, power, and sensors. Various concepts for use in the design of the combination passive damper were considered, with attention given to establishing compatibility between an eddy current damper and a hysteresis damper. An attitude sensor subsystem has been selected which meets the requirement for monitoring vehicle attitude. Reliability and control activity are considered; and an appendix deals with determination of gravity gradient stabilization for ATS pitch, roll, and yaw angles from solar aspect information. M.W.R.

N66-24503*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
GRAVITY GRADIENT STABILIZATION SYSTEM FOR THE APPLICATIONS TECHNOLOGY SATELLITE Fifth Quarterly Progress Report, 1 Jul.–30 Sep. 1965

20 Oct. 1965 189 p *its* Doc.-65SD4464
(Contract NAS5-9042)
(NASA-CR-74572) CFSTI: HC $5.00/MF $1.25 CSCL 22B

Systems evaluation and integration efforts are reported for the Applications Technology Satellite (ATS), and attention is given to various parts of the flight evaluation plan. Results are presented for analytical studies dealing with (1) vehicle attitude errors due to vehicle magnetic dipole and (2) TM-2 system response to pulsing thrustor. Boom thermal bending analysis and orbital excitations are considered. Progress is reported for the combination passive damper and the attitude sensor subsystem. Various engineering evaluation, qualification, and flight acceptance tests are discussed. Quality control and inspection procedures are considered; along with reliability, parts and standards, materials and processes, and manufacturing. Appendices deal with (1) cable cutting malfunction analysis, (2) vibration test plan for combination passive damper dynamic model, and (3) limit switch configuration analysis. M.W.R.

N66-24504*# Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
ARIEL II ENGINEERING DATA ANALYSIS, PHASE II
8 Sep. 1965 103 p
(Contract NAS5-9104)
(NASA-CR-74539) CFSTI: HC $4.00/MF $0.75 CSCL 22B

Dynamic performance, power system performance, and thermal behavior are considered for a post-launch evaluation of the ARIEL II satellite. Predicted and actual spacecraft performance are compared; and details are included on spin rate and acceleration, solar aspect angle and position, perigee position and velocity vector, right ascension of ascending node, angle between initial spin axis and perigee velocity vector, and initial spacecraft orientation. Regulated voltage, battery, and solar array are discussed for the power system. Actual thermal performance is compared with predictions that were made. M.W.R.

N66-24505*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
GRAVITY GRADIENT STABILIZATION SYSTEM FOR THE APPLICATIONS TECHNOLOGY SATELLITE Fourth Quarterly Progress Report, 1 Apr.–30 Jun. 1965
20 Jul. 1965 80 p *its* Doc.-65SD4381
(Contract NAS5-9042)
(NASA-CR-74536) CFSTI: HC $3.00/MF $0.75 CSCL 22B

The Applications Technology Satellite (ATS) data processing system design and the flight evaluation plan are documented; and reports are presented on capture analysis for the ATS-A vehicle, thrustor and flywheel inversion, and hysteresis damping. Analytical and design efforts have been discontinued on the variable torque hysteresis damping concept. The O-ring seal used in the boom drive assembly is evaluated, and results of lubrication tests are reported. Photographs illustrate the developmental models of the transmission assembly, TV tip targets, and test fixtures. An analysis is presented of the solar aspect sensor detector–electronics interface, and reliability analyses are reported for the sensor and the passive hysteresis damper. An analytical description is given for a damagnetic shaft support for use in orbiting satellites, the mathematical model developed for this support is applied to a complex shaft loading condition, and computer solutions are presented. M.W.R.

N66-24547*# Hayes International Corp., Birmingham, Ala.
LAUNCH VEHICLE WIND RESPONSE BY STATISTICAL METHODS Engineering Report No. 1193
J. E. Bailey 29 Nov. 1965 72 p refs
(Contract NAS8-20201)
(NASA-CR-74639) CFSTI: HC $3.00/MF $0.75 CSCL 22D

A new approach to the problem of large flexible booster response to lateral wind inputs during launch is used as a means of simplifying the load minimum control problem. Statistical analysis methods, which include generalized harmonic analysis and adjoint techniques are used to provide a different approach to the control law evaluation and optimization procedure. Statistical techniques applicable to the problem of launch vehicle response calculation are discussed for the general case which includes a time varying system mathematical model and nonstationary random input process. The input process (i.e. the lateral wind input) is assumed to be stationary in space and time varying due only to the changing vehicle velocity. Methods are presented for determining root-mean-square bending moment and lateral drift for stationary constant coefficient system models and the general nonstationary case. Various representations of the wind input are presented and their degree of simulation of the general wind profile data is discussed. As a means of illustrating application of the techniques which are discussed, a constant coefficient Saturn V model at maximum dynamic pressure is studied. Effect of various control system feedback schemes on load and drift are presented. Author

N66-24556# General Dynamics/Convair, San Diego, Calif.
BIBLIOGRAPHY OF RESEARCH AND DEVELOPMENT REPORTS ON THE CENTAUR PROGRAM FOR THE THIRD QUARTER 1965
C. L. Stevens 15 Nov. 1965 138 p refs
(GDC-ACW64-027F)

A bibliography is presented of research and development reports on the Centaur program. Included are reports on acceptance tests, actuators, adapters, antennas, autopilots, batteries, bulkheads, cables, computers, configuration, connectors, control systems, destructors, electric and electronic equipment, fairings, firing and flight tests, ground support equipment, guidance systems, gyros, handling, helium, hydraulic systems, hydrogen peroxide, instrumentation systems, insulation, launching, loads, maintenance, flight parameters, pneumatic systems, pressurization systems, programmer, propellant and propulsion systems, pumps, quality control, range safety systems, reliability tests, safety, separation systems, specifications, static tests, stress analysis, structures, Surveyor, switches, telemetry, test equipment, testing, tracking system, trajectories, transducers, valves, and weight and balance. R.N.A.

N66-24576*# Hayes International Corp., Birmingham, Ala.
SIMPLIFIED CRITERIA FOR MINIMUM LOAD AND DRIFT CONTROL OF LARGE BOOSTER VEHICLE Engineering Report No. 1214
D. L. St. John 22 Dec. 1965 44 p refs
(Contract NAS8-20201)
(NASA-CR-74461) CFSTI: HC $2.00/MF $0.50 CSCL 22D

A re-evaluation of control system criteria for minimizing lateral drift and structural loading of large booster vehicles during launch is made. A simplified mathematical rigid body booster model, neglecting engine gimbal and accelerometer dynamics and employing lateral acceleration feedback, is used in the analysis in order that fundamental concepts can be simply illustrated. Basic understanding of the minimum drift and minimum load control criteria is obtained using a servo analysis approach in conjunction with statistical design techniques. Simplified lateral drift and bending moment closed-loop transfer functions due to lateral wind disturbances are

derived from application of root locus and frequency response analysis to the rigid booster model. Correlation of the simplified and exact transfer function representation of the vehicle response is accomplished with an approximate statistical model of the lateral wind input. Statistical techniques are used as an aid in determining basic criteria for minimum load and minimum drift control. Criteria for minimum drift control are easily defined, while the criteria for minimum load control are not so apparent. Author

N66-24835*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGNETIC FIELD RESTRAINTS FOR IMPs F AND G
Norman F. Ness 9 Jul. 1964 15 p
(NASA-CR-55444; X-672-64-197) CFSTI: HC $1.00/MF $0.50 CSCL 22B

To insure the success of magnetic field experiments on the IMP F and G spacecraft, it is necessary that contaminating magnetic fields associated with permanent and induced magnetization or circulating currents on the spacecraft be kept to an absolute minimum. This report outlines the acceptable magnetic testing procedures which are necessary for the spacecraft's success. Recommendations about fabrication of electronic structures and wiring of packages and solar cells are presented which minimize the magnetic field noise levels associated with these individual problem areas. These recommendations present state of the art techniques which proved successful in solving the spacecraft magnetic field contamination problems on IMPA. R.N.A.

N66-24765# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
A COMPARATIVE SIZE AND WEIGHT SENSITIVITY STUDY OF THE HL-10 AND SV-5 LIFTING VEHICLE CONFIGURATIONS
R. J. De Bellis, D. E. Dunlap, and P. W. Scott Sep. 1965 91 p refs
(SM-48193)

The effect of man's size, and various mission parameters on the size and weight of two similar lifting vehicles, the HL-10 and SV-5 configurations, were determined. These vehicles fall into the same class of hypersonic lift-to-drag ratios and have similar shapes. The results of the study show the comparison of the vehicles and indicate the areas in which one configuration may be preferred over the other. The study consisted of (1) determination of geometrical sensitivities in which anthropometry, maximum crew and passenger capacity, maximum balanced volume, and vehicle size sensitivity to man size and seating arrangement were investigated; and (2) a weights analysis in which the vehicle weight sensitivity to mission type, mission duration, seating arrangement, number of personnel, vehicle length, and subsystem placement were investigated. Data are graphically depicted; conclusions drawn from the data are stated; and recommendations are made. L.S.

N66-24929*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ANCHORED INTERPLANETARY MONITORING PLATFORM AIMP (D AND E): E.T.R. OPERATIONS CHECK-OFF LIST
E. W. Travis, D. K. Mc Carthy, R. L. Courtney, and D. L. Miller May 1966 160 p
(NASA-TM-X-55472; X-723-66-215) CFSTI: HC $5.00/MF $1.00 CSCL 22B

The necessary procedures are listed for insuring that all mechanical systems (including experiments, fasteners, screws, despin systems, etc.) are properly and permanently inserted in the Anchored Interplanetary Monitoring Platform (AIMP). Instructional data are given, and check-off lists and calculation and data sheets are included. System schematics and installation drawings amplify the text. M.G.J.

N66-25001*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE VIEW FROM RANGER
James H. Wilson [1965] 61 p refs
(Contract NAS7-100)
(NASA-EP-38) GPO: $0.40; CFSTI: MF $0.75 CSCL 22B

The successful lunar photographic mission of Ranger VII is examined from its inception, to the transmission of more than 4300 photographs of the moon's surface. Background material is provided which includes discussions of early astronomers who studied the moon's surface with the aid of a telescope; the possibilities of using rockets for space exploration; a description of the Atlas/Agena launch vehicle; and an account of the actual launch. The value of this mission within the framework of ensuing lunar and space explorations is cited and an analysis of selected photographs of the lunar surface is given. H.S.W.

N66-25018*# Systems Technology, Inc., Hawthorne, Calif.
TRANSFER FUNCTION APPROXIMATIONS FOR LARGE HIGHLY COUPLED ELASTIC BOOSTERS WITH FUEL SLOSH
R. L. Stapleford, L. G. Hofmann, J. J. Best, C. D. Wezeman, and W. A. Johnson Washington, NASA, Apr. 1966 173 p refs
(Contract NAS8-11419)
(NASA-CR-464) CFSTI: HC $5.00/MF $1.25 CSCL 22B

Approximations are derived for the transfer function factors (poles, zeros, gain) of a large highly flexible liquid-fueled boost vehicle. Various levels of approximations are evaluated and compared with exact factors for a hypothetical eleven-degree-of-freedom vehicle, the MSFC Model Vehicle No. 2. Agreement within 1 to 5 percent is achieved, depending on the amount of coupling taken into account. The approximations are developed to provide physical insights to the basic dynamic characteristics of the vehicle, to allow simplified but meaningful preliminary synthesis studies, and to rapidly identify and evaluate the effects of variation in vehicle characteristics. The results explain or increase the understanding of previously observed coupling phenomena and provide ready means of assessing, by inspection or relatively simple computation, the consequences of change in vehicle characteristics. They also may be employed at the preliminary analysis and synthesis level to provide appropriate vehicle models without requiring large scale digital or analog computer facilities. Author

N66-25154# Weather Bureau, Washington, D. C.
SECOND ESSA SATELLITE LAUNCHING SCHEDULED FEBRUARY 25
Washington, NASA [1966] 25 p
(ES-66-14)

A description is presented of the Tiros Operational Satellite (TOS) system which is designed to provide global meteorological data on a daily basis without interruption. The TOS system will provide regular and continuous cloud picture coverage of the entire sunlit portion of the earth at least once per day, and certain infrared observations of value to meteorology will also be made. A discussion is included of the ESSA 8 Satellite which points out the role of this satellite in the overall meteorological satellite system. The automatic picture transmission cameras and other subsystems are described. The launch dates, lifetimes, and the number of meteorologically usable pictures received from other weather satellites are listed. H.S.W.

N66-25179# Library of Congress. Washington, D. C. Aerospace Technology Div.
SPACECRAFT UTILIZING THE LIFTING REENTRY TECHNIQUE. PART II. SECTION I: COMPREHENSIVE REPORT. SECTION II: ANNOTATED BIBLIOGRAPHY
Victor Klein, Alexis Baratoff, and Ivan M. Soukhanov 1 Apr. 1966 325 p refs
(ATD-66-34)

This report is based on Soviet-Satellite open sources published 1957–1964, although some earlier articles are included. Theoretical studies in lifting reentry are reviewed. Part 1 (reentry and recovery of Soviet manned space vehicles) dealt with descriptions of launchings, flights, and reentries of Vostok-type space vehicles. Part II comprises a comprehensive report, and an annotated bibliography. Although the two sections are bound in one volume, they are independently paginated and have separate tables of contents. Section I is a comprehensive review of sources on theoretical and experimental studies of problems in fields of space sciences, i.e., problems of lifting and ballistic hypervelocity flight, and atmospheric reentry techniques. There are four parts following the introduction: high-speed aerodynamics and gas dynamics, high-speed aerothermodynamics, high-speed flight mechanics, and strength of flight-vehicle components (thin and sandwich plates and shells). A brief conclusion is given. Section II is an annotated bibliography containing 861 entries arranged by subject: aeromechanics of high-speed flows, aerothermodynamics of high-speed flows, flight mechanics, strength of space vehicle components, and miscellaneous. Within each subject group, the entries are further arranged chronologically by year of publication and source. There are three appendices to Section II: Appendix A. list of source abbreviations, Appendix B. glossary of abbreviations, and Appendix C. alphabetical index of authors and associations. Author

N66-25193# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Missile and Space Systems Div.
SATURN IB PAYLOAD PLANNER'S GUIDE
L. O. Schulte and D. D. Wheeler Jun. 1965 59 p
(SM-47010)

This Saturn IB payload planners guide is intended as a starting point for engineers, scientists, and executives who plan to conduct engineering tests or experiments in the space sciences. Technical aspects of the vehicle are given, and the procedures are outlined with which large prime, or small auxiliary payloads can be effectively integrated and flown. Presented are the characteristics of the launch vehicle, its performance, the accommodations it offers to potential experimenters, suggested procedures to be followed in obtaining support for experiments, and approximate flight schedules needed to initiate the design of a payload. A concept-to-flight chronology of events is included to support payload/launch vehicle system planning, and major subsystems of the launch vehicle and their relation to the payloads are described. C.T.C.

N66-25194# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Missile and Space Systems Div.
SATURN V PAYLOAD PLANNER'S GUIDE
L. O. Schulte Nov. 1965 67 p
(SM-47274)

A Saturn V payload planner's guide which is intended to be used as a starting point for engineers, scientists, and executives who are planning to conduct engineering tests, space science experiments, or operational missions is presented. It outlines, for the payload planner, the technical information and procedures with which large prime, or small auxiliary payloads can be effectively integrated and flown on the vehicle. Included are characteristics of the Saturn V launch vehicle, its performance, the accommodations it offers to potential experimenters, suggested procedures to be followed in obtaining support for experiments, approximate flight schedules, and engineering data needed to initiate the design of a payload. The major subsystems of the launch vehicle and their relation to the payloads are described, and a concept-to-flight chronology of events is presented to support payload/launch vehicle system planning. C.T.C.

N66-25263# Stanford Univ., Calif. School of Engineering.
SAMPLER: STANFORD ADVANCED MARS PROJECT FOR LIFE DETECTION, EXPLORATION AND RESEARCH
John R. Kiely, ed. Jun. 1965 543 p refs

A proposal for a Voyager mission to Mars in 1971 with the goals of detecting life and preparing the way for later manned and unmanned missions is presented. In this proposal the Saturn IB will be used to send three identical spacecraft to Mars. Each spacecraft will consist of a non-sterile orbiter and two sterile landers. The landers will use tension shell heat shields, parachutes, and impact attenuation material to reduce their impact velocity. Among the major aspects of the design are an 18 foot diameter communications antenna with a bandwidth capability of 250,000 bits/sec; a solar cell power supply for the orbiter; a low speed digital computer for the data reduction and experiment control on the landers; a modified version of the automated biological laboratory built around a mass spectrometer–gas chromatograph combination; a stellar stabilized attitude control system; and lander experiments and electronics which can withstand a sterilizing heat cycle of 135°C for 24 hours. C.T.C.

N66-25367*# National Aeronautics and Space Administration, Washington, D. C.
MANNED SPACE FLIGHT: PROJECT APOLLO
[1966] 16 p
(NASA Facts, Vol. III, No. 1) GPO: $0.15 CSCL 22B

The Apollo project in the manned space flight program is briefly discussed. The Apollo spacecraft and the Saturn launch vehicles are illustrated. The command module, lunar excursion module, guidance and navigation system, and moon flight tracking system are described. The astronaut wardrobe and training are mentioned, and the trajectories are diagrammed. N.E.N.

N66-25369*# National Aeronautics and Space Administration, Washington, D. C.
MANNED SPACE FLIGHT: PROJECTS MERCURY AND GEMINI
Jan. 1966 16 p Revised
(NASA Facts, Vol. II, No. 8) GPO: $0.20 CSCL 22B

The Mercury and Gemini projects in the manned space program are discussed. The spacecraft, launch vehicle, and target vehicle are briefly described. The guidance system, environmental control system, tracking network, and rendezvous mission are mentioned. Descriptions of astronaut training, and biomedical and bioastronautic experiments are included. N.E.N.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N66-23980# Air Force Special Weapons Center, Kirtland, AFB, N. Mex.

SIMULATION DEVICES FOR USE IN STUDIES OF PROTECTIVE CONSTRUCTION Technical Report, 1 Jan.–31 Dec. 1965

James A. Mahoney Feb. 1966 225 p refs

(AFWL-TR-65-224; AD-629607) CFSTI: HC $6.00/MF $1.25

The report contains information on dynamic loading simulation devices that were either designed or could be modified for use in studies of protective construction. The information includes the following items: (1) the type of device, (2) the owner and location, (3) the loading characteristics, (4) the physical description, (5) the driver used, and (6) a short discussion concerning the device and its present use. Pictures and diagrams are also furnished for the majority of the devices. Author

N66-23999# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CALCULATION OF FREE, JOINT BEND-TWIST OSCILLATIONS OF REVOLVING HELICOPTER BLADE

M. B. Vakhitov *In its* News of Inst. of Higher Learning 6 Jan. 1966 p 47–69 refs (See N66-23994 13-01) CFSTI: HC $26.30/MF $1.25

A matrix method is used in calculating the free bend-twist oscillations of a revolving helicopter blade. The mass of the blade is considered continuous throughout the length, and the joints are considered to be in torsional bending. Assumptions are that the blade does not have geometric twist; the elastic center in every section lies on the main central axis of inertia; the flexural axis is a straight line; and the flap hinge lies on the axis of rotation of the blade. C.T.C.

N66-24000# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

FREE OSCILLATIONS OF CIRCULAR ORTHOTROPIC CONICAL SHELLS

V. G. Godzevich *In its* News of Inst. of Higher Learning 6 Jan. 1966 p 70–79 refs (See N66-23994 13-01) CFSTI: HC $26.30/MF $1.25

This paper considers the problem of free oscillations of a truncated circular conical shell reinforced in two main directions by closely placed stiffening ribs. It is assumed that the stiffening ribs are located asymmetrically relative to the mean surface of the shell. To simplify the calculation the asymmetrical ribs are considered as symmetrical. It is shown that disregarding the asymmetry of the stiffening ribs can lead to certain errors. R.N.A.

N66-24001# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SUPPORTING POWER OF CIRCULAR CYLINDRICAL SHELLS UNDER FLEXURE

S. N. Kan *In its* News of Inst. of Higher Learning 6 Jan. 1966 p 80–88 (See N66-23994 13-01) CFSTI: HC $26.30/MF $1.25

An attempt is made to determine the failure strength of an unreinforced, smooth shell based on a geometrical linear theory. Also determined is the strength of the shell from the condition of stability during pure bend. The shell is considered horizontally oriented, and subject to action of pure flexure and radial pressure. C.T.C.

N66-24002# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CALCULATION OF AXISYMMETRIC STRESSED STATE OF CYLINDRICAL SHELLS IN THE PRESENCE OF DISCRETELY LOCATED ELASTIC FRAMES

Yu. I. Kaplan *In its* News of Inst. of Higher Learning 6 Jan. 1966 p 89–101 refs (See N66-23994 13-01) CFSTI: HC $26.30/MF $1.25

This article considers the effect of discretely located elastic frames on the strength, longitudinal-transverse bend, stability, and free oscillations of cylindrical shells. It is assumed that the intermediate frames are elastic in their own plane and, at the same time, absolutely flexible out of plane. The end frames can be both rigid and elastic. In solving the problems, the equations of S. N. Kan are used for orthotropic cylindrical shells, the integrals of which are recorded in the form of a Clebsch row with the help of four initial parameters. Every intermediate frame introduces only one constant which is found from the natural boundary conditions of the mixed variational problem. The problem, independent of the number of elastic intermediate frames, is reduced to finding only four constants, which are determined by the properties of the end frames. The system of equations for these constants is recorded in the common form, independent of number, elastic properties, and distance between intermediate frames. R.N.A.

N66-24003# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPLICATION OF METHOD OF CONSECUTIVE APPROXIMATIONS TO PROBLEMS OF STABILITY OF PLATES

V. Ye. Popovich *In its* News of Inst. of Higher Learning 6 Jan. 1966 p 102–111 refs (See N66-23994 13-01) CFSTI: HC $26.30/MF $1.25

Problems dealing with plate stability are solved by the method of consecutive approximations. A method which reduces the eigenvalues of differential equations with variable coefficients to an algebraic equation relative to an unknown parameter, is used in determining the critical parameters. Assumptions used in formulating the problem are given, and three examples are included to demonstrate the value of the applied methods. C.T.C.

N66-24004# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

GRAPHOANALYTICAL METHOD OF DESIGNING OF MECHANISMS

V. M. Khaldeyev *In its* News of Inst. of Higher Learning 6 Jan. 1966 p 112–127 refs (See N66-23994 13-01) CFSTI: HC $26.30/MF $1.25

A graphoanalytical method of designing mechanisms which is based on methods of graphostatics and simply derived rules is presented. This method allows the recording of necessary analytic dependencies between drive and kinematic parameters directly from force plans. The major conclusion is that the method is useful for designing any two-dimensional mechanism, and is especially convenient when the location of the mechanism is strictly limited by conditions of the arrangement. C.T.C.

N66-24009# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATION OF BEND STRESSES OF NONUNIFORMLY HEATED REVOLVING DISKS
Z. S. Palley *In its* News of Inst. of Higher Learning 6 Jan. 1966 p 171-180 refs (See N66-23994 13-01) CFSTI: HC $26.30/MF $1.25

A method is given for the calculation of the bend stresses on nonuniformly heated, revolving disks, which considers the changeability of elastic modulus, coefficients of linear expansion, and transverse deformation on the radius of the disk. The methods used by previous investigators for these calculations are discussed and compared to this final difference method. In deriving the general equations, it was assumed that load and temperatures are distributed axisymmetrically, the sag of the middle plane is small, and cross sections remain flat during the bend. To appraise the accuracy of the method, graphs are provided which were constructed from the calculations. H.S.W.

N66-24020# Naval Research Lab., Washington, D. C. The Shock and Vibration Information Center.
THE SHOCK AND VIBRATION BULLETIN, NUMBER 35, PART 3
Jan. 1966 282 p refs 35th Symp. on Shock, Vibration and Assoc. Environments held in New Orleans, 25-28 Oct. 1965; sponsored by NASA
(AD-628600) CFSTI: HC $6.00/MF $1.50

Symposium papers on structural analysis in relation to shock, vibration, and related phenomena are presented. For individual titles see N66-24021-N66-24042.

N66-24021# Northrop Corp., Hawthorne, Calif. Norair Div.
ON THE RESPONSE OF ROCKET VEHICLE STRUCTURE TO CERTAIN ENVIRONMENTAL LOADS
John C. Yao *In* NRL The Shock and Vibration Bull., No. 35, Pt. 3 Jan. 1966 p 1-8 refs (See N66-24020 13-32) CFSTI: HC $6.00/MF $1.50
(Contract NAS8-5308)

An analytical and experimental study is made of the response of a typical rocket vehicle structure subjected to oscillating surface pressure of arbitrary space distribution and internal pressure. Unlike the conventional approach, in which the structure is treated as an orthotropic shell, each shell element or stiffening ring is considered for the first time as an individual structural element. Closed form solution for each structural element is used, and the boundary conditions and continuity conditions between those structural elements are satisfied. Analytical results so obtained show reasonable agreement with the experimental data. Author

N66-24022# Northrop Corp., Hawthorne, Calif. Norair Div.
EFFECTS OF ORTHOTROPIC CORES ON THE FREE VIBRATIONS OF SANDWICH PLATES
M. L. Jacobson *In* NRL The Shock and Vibration Bull., No. 35, Pt. 3 Jan. 1966 p 9-14 refs (See N66-24020 13-32) CFSTI: HC $6.00/MF $1.50

Orthotropic cores may have a significant effect on the vibrations of thin-faced, rectangular sandwich plates. Natural frequencies in non-dimensional form of simply supported sandwich plates are obtained as a function of nondimensional parameters depicting stiffness, aspect ratio, and the ratio of shear moduli of an orthotropic core. The results apply to orthotropic plates with honeycomb cores, corrugated cores, etc., when a linear, elastic, small deflection analysis is applicable. Figures are presented showing the effects of core orthotropicity and plate aspect ratio on the fundamental frequency. The effect of the core shear modulus on cross section rotations and midsurface rotations during flexural vibrations is determined for simply supported honeycomb plates with isotropic cores. The ratio of cross section rotation to midsurface rotation is shown to be an expected measure of stiffness of the plate. Author

N66-24023# Sperry Rand Corp., St. Paul, Minn. UNIVAC Div.
THE EFFECT OF INERTIA VARIATION AND CERTAIN ASYMMETRIES ON THE DYNAMIC RESPONSE OF AN ELASTICALLY-COUPLED SYSTEM
Darrell A. Frohrib *In* NRL The Shock and Vibration Bull., No. 35, Pt. 3 Jan. 1966 p 15-20 refs (See N66-24020 13-32) CFSTI: HC $6.00/MF $1.50

There appear to be no concise solutions in the literature for the general dynamic response of the two-dimensional rigid body supported on a beam-like suspension in which flexibility, inertia, and input asymmetries exist. This paper supplies these solutions, and interprets the eigenvalue problem to supply rapid predictions of eigenvalue and mode shape changes due to small inertia variations in the suspended item from a given inertial configuration. Author

N66-24024# Rocketdyne, Canoga Park, Calif.
STEADY-STATE RESPONSE OF A MULTIDEGREE OF FREEDOM SYSTEM SUBJECTED TO RANDOM EXCITATION
J. J. Vaccaro *In* NRL The Shock and Vibration Bull., No. 35, Pt. 3 Jan. 1966 p 21-26 refs (See N66-24020 13-32) CFSTI: HC $6.00/MF $1.50

A direct spectral analysis method is presented for determining the steady-state power spectral density and mean square responses of a multidegree of freedom system subjected to random excitation. This method is applicable to structural systems subjected to base excitation or discrete point loading. A nonmodal-type solution is obtained, using the properties of normal modes in the formulation of the transfer function matrix, thus averting numerous, complex matrix inversions. The analytical method presented has demonstrated its usefulness in predicting the response of rocket engine components and in interpreting experimental data. An example is given, illustrating the use of this method to determine the response of a 6 degrees of freedom, base-excited turbopump model. Author

N66-24025# Aerospace Corp., San Bernardino, Calif.
VIBRATIONS OF MULTILAYER SHELLS OF REVOLUTION UNDER DYNAMIC AND IMPULSIVE LOADING
Stanley Klein *In* NRL The Shock and Vibration Bull., No. 35, Pt. 3 Jan. 1966 p 27-44 refs (See N66-24020 13-32) CFSTI: HC $6.00/MF $1.50

The paper describes a matrix displacement finite element approach to the linear elastic dynamic analysis of multilayer shells of revolution under axisymmetric and asymmetric loads. The shell is idealized as a series of conical frusta, joined at nodal circles. The derivation of the mass and stiffness matrices for a shell structure is outlined. A method for solution of the equations of motion is described for this particular type of problem, with special emphasis on the computational aspects of the solution. An especially appropriate finite difference technique is used along with a method for efficiently utilizing the digital computer memory to store and solve a large system of linear simultaneous equations. A method for handling shells under impulsive loading is also discussed. The solution for a shallow spherical cap under time-varying axisymmetric pressure load indicated the scope, speed, and accuracy of the solution method. Author

N66-24026# Southampton Univ. (England). Inst. of Sound and Vibration Research.
THE RANDOM VIBRATIONS OF A MULTI-SUPPORTED HEAVILY-DAMPED BEAM
Denys J. Mead and Emily F. Wilby *In* NRL The Sound and Vibration Bull., No. 35, Pt. 3 Jan. 1966 p 45–55 refs (See N66-24020 13-32) CFSTI: HC $6.00/MF $1.50
(Contract AF 61(052)-504)

A conventional analysis of the random vibrations of a lightly-damped multi-supported beam considers the response of each significant normal mode and then adds these responses statistically. Difficulties arise when the damping is large and differs from mode to mode, at the same time as the modal density is high and damping coupling exists between the modes. This paper presents a method of analysis which avoids these difficulties by dropping the normal mode approach and by seeking a closed form solution to the harmonic frequency response functions for the beam. The method becomes particularly straightforward when the supports are at regular intervals, and attention is therefore concentrated on this particular system. The effects of rotational restraints at the supports are readily incorporated in the analysis. Some computational results are discussed which show the effects of rotational restraints and internal beam damping on the response of the beam to random loading. The application of these results to multi-stiffened airplane skin-structures is finally considered. Author

N66-24027# California Inst. of Tech., Pasadena.
CUMULATIVE DAMAGE CAUSED BY SHOCK EXCITATION
Sami F. Masri *In* NRL The Shock and Vibration Bull., No. 35, Pt. 3 Jan. 1966 p 57–71 refs (See N66-24020 13-32) CFSTI: HC $6.00/MF $1.50
(Contract AF 29(601)-4909)

Glass pin-ended beams were subjected to a series of half-sine pulses on a drop table. The maximum bending stress in the beam was correlated with the number of pulses required for failure. Dynamic fatigue properties of the glass under sinusoidal stress variations were determined on a variable speed, reversed bending, fatigue test machine. Similar tests were made on polystyrene plastic cantilever beams. As expected for such materials, there is a large scatter in experimental results and it is evident that a simple linear damage accumulation law cannot satisfactorily explain the measurements. It is shown that a simple extension of the linear law, involving an increasing weight for the initial cycles of relatively high stress, can produce a cumulative damage expression which fits the experimental data for both glass and plastic. A similar extension can be shown to give excellent results for mild steel by using experimental data from Tanaka. Author

N66-24028# Martin Co., Denver, Colo.
SOME LATTICE VIBRATION PROBLEMS
George W. Morgenthaler *In* NRL The Sound and Vibration Bull., No. 35, Pt. 3 Jan. 1966 p 73–80 refs (See N66-24020 13-32) CFSTI: HC $6.00/MF $1.50

The subject of vibration of linear and nonlinear lattices has received increased attention in recent literature because of the implications for understanding the motion of a shock wave through materials. In the present paper two such problems are considered. As early at 1910, Havelock investigated the propagation of disturbances through an infinite lattice of similar masses connected by linear springs. Transform methods for solving differential-difference equations are applied to include the effects of a restoring medium and the viscous damping of the particle motion, which represents energy losses in the wave. A class of such problems is solved and an example is given. For various classes of finite, nonlinear, N-degree-of-freedom lattices, R. Rosenberg has defined and shown the existence of nonlinear normal modes. It is shown that for some lattices there exist forcing functions for which the response of the system is a modal motion. It is possible to select a forcing function which gives the same oscillatory motion for each particle as the input oscillation. Author

N66-24029# Argonne National Lab., Ill.
THE SOLUTION OF DYNAMIC BEAM PROBLEMS BY MEANS OF FINITE CIS-HYPERBOLIC TRANSFORMS
Gabriel Cinelli *In* NRL The Shock and Vibration Bull., No. 35, Pt. 3 Jan. 1966 p 81–88 refs Sponsored by AEC (See N66-24020 13-32) CFSTI: HC $6.00/MF $1.50

It has been shown that the solution of partial differential equations for finite regions can be solved by using integral transforms with suitable kernels. These equations could be solved by the classical method of separating variables, but the integral transform gives the solution in a more direct manner since the boundary conditions are contained in the solution. The purpose of this paper is to develop finite transforms for the solution of the differential equation associated with the transverse motion of a uniform elastic beam for all possible boundary conditions. The method used in developing the transforms is shown for the case of a cantilevered beam. This transform is used to find the motion of a cantilevered beam with load and viscous damping, when the forcing function and boundary conditions are time-dependent. The finite transforms, inverse infinite series, and operational properties are tabulated for all possible boundary conditions. It is then shown how these new transforms provide a new means for determining the 'point' and 'transfer' mechanical impedance of a beam. Author

N66-24030# Martin Co., Orlando, Fla.
RANDOM VIBRATIONS AND RANDOM FUNCTIONS
Clifford S. O'Hearne *In* NRL The Shock and Vibration Bull., No. 35, Pt. 3 Jan. 1966 p 89–94 refs (See N66-24020 13-32) CFSTI: HC $6.00/MF $1.50

The opinion is presented that the random vibration theory used in practice is too vague and that it would be useful to make it more rigorous primarily by bringing it in closer contact with relevant random function theory. The contention is argued by pointing to problems of understanding and evaluating definitions and methods in the well-known literature. An attempt is made to draw support from both sides for the argument that use of more coherent and disciplined mathematical theory is needed in engineering random vibration work. C.T.C.

N66-24031# Hughes Aircraft Co., El Segundo, Calif.
ANALYTICAL AND EXPERIMENTAL TECHNIQUES USED TO ESTABLISH STRUCTURAL DESIGN LOADS FOR THE SURVEYOR SPACECRAFT DURING LUNAR LANDING
R. J. Harter and R. J. Switz *In* NRL The Shock and Vibration Bull., No. 35, Pt. 3 Jan. 1966 p 95–106 ref Prepared for JPL (See N66-24020 13-32) CFSTI: HC $6.00/MF $1.50
(Contracts NAS7-100; JPL-950056)

A series of techniques has been developed to calculate detailed structural loads for Surveyor during the touchdown phase, using experimental and analytical data. This paper describes the processes used, and compares the predicted loads with results from full scale drop tests. Author

N66-24032# Bell Aero Systems Co., Buffalo, N. Y.
DYNAMIC ASPECTS OF METAL BELLOWS
Vincent R. Daniels *In* NRL The Shock and Vibration Bull., No. 35, Pt. 3 Jan. 1966 p 107–124 refs (See N66-24020 13-32) CFSTI: HC $6.00/MF $1.50

The major resonant vibration modes in both the longitudinal and lateral directions were identified, analytically and experimentally, for single- and double-ply bellows. The more common longitudinal bellows mode, wherein the response is similar to that of an elastic bar or coil spring fixed at each end, was named the accordion mode. A second longitudinal mode, discovered rather unexpectedly, was named the liquid mode, because of the metal–liquid interface coupling. This mode is potentially dangerous because of the induced liquid pressure oscillations that occur inside the bellows. Attenuation devices, such as protruding ring baffles and dense gas pressurization, were investigated to minimize resonance. Simple formulas and matrices for digital computer solutions were established for computing longitudinal and lateral bellows vibration modes, for nearly every conceivable combination of internal and external liquids and gases operating with and without pressurization. Author

N66-24033# Technik, Inc., Jericho, N. Y.
LIFETIME EVALUATION PROCEDURES FOR RANDOM SHOCK AND VIBRATION
M. Zaid and P. Marnell *In* NRL The Shock and Vibration Bull., No. 35, Pt. 3 Jan. 1966 p 125–147 refs (See N66-24020 13-32) CFSTI: HC $6.00/MF $1.50

This paper presents procedures for evaluating the lifetime of a structure subjected to random vibration and random shock. As a specific example, a filament lamp structure is treated in detail. The random vibration procedure obviates extensive analysis through the introduction of a unique concept relating fatigue life to filament deflection. For a random shock environment, the lamp filament is analyzed as an elastic–plastic system subject to step-shock inputs of random intensity. A cumulative damage concept for shock is introduced, which leads to a straightforward evaluation of the average number of random shocks to failure. In both cases, a combination of theoretical and experimental techniques is utilized to obtain dependable evaluation procedures with minimal expenditures of time and effort. Specific examples are included for purposes of illustration and verification of the methods. Author

N66-24034# Chrysler Corp., New Orleans, La. Space Div.
APPLICATION OF THE DIRECT STIFFNESS METHOD TO THE ELASTIC MATHEMATIC MODELING OF THE SATURN S-IB
M. E. Mc Coy, J. D. Sowers, W. J. Leaumont, and R. G. G. Higgins *In* NRL The Shock and Vibration Bull., No. 35, Pt. 3 Jan. 1966 p 149–159 refs (See N66-24020 13-32) CFSTI: HC $6.00/MF $1.50

The clustered-shell launch vehicle, although a proven expedient for obtaining the high thrust required for manned space missions, has introduced a new order of magnitude problem in structural and dynamic analyses. High redundancy, plus the impracticability of a full-scale static test of a Saturn vehicle, has given impetus to the derivation of an advanced elastic mathematical model for analyzing the internal loads distribution on the various components of the S-IB stage cluster. This paper describes how such a model has been constructed by the stiffness matrix method and utilized in both static and dynamic studies. Author

N66-24036# Northrop Corp., Hawthorne, Calif. Nortronics.
ANALYSIS OF THE EFFECTS OF DYNAMIC COUPLING BETWEEN STRUCTURAL RESONANCES AND A TIME SAMPLING DATA CONTROL SYSTEM
L. R. Beuder and J. M. Brust *In* NRL The Shock and Vibration Bull., No. 35, Pt. 3 Jan. 1966 p 169–186 refs (See N66-24020 13-32) CFSTI: HC $6.00/MF $1.50

This paper is intended to illustrate a typical "vibration" problem which is likely to confront a dynamicist working in the field of inertial and astroinertial guidance. It describes a dynamic coupling phenomenon between a structural resonance and the response of a star tracker in an actual astroinertial guidance instrument which was subjected to vibration. The structural resonance is shown to cause a relative translational motion between the rotor and stator of a resolver used as an angular sensing device in a star tracker control loop. The translational motion is shown to result in an angular positional error which propagates through the control loop and causes excessive angular motion, or hunting of the star tracker. An analysis is performed to determine the natural frequency of the structure supporting the resolver. The resolver error versus rotor-stator displacement is determined empirically. A further analysis is performed which illustrates how both sinusoidal and random vibration propagates through the tracker loop via the resolver, resulting in the excessive tracker motion. Experimental verification of the above analyses is presented showing excellent correlation between analysis and test. Author

N66-24037# Sandia Corp., Albuquerque, N. Mex.
TRANSIENT RESPONSE OF LINEAR DAMPED, LUMPED, SPRING-MASS SYSTEMS BY EXPERIMENTALLY DERIVED TRANSFER FUNCTIONS
R. W. Kelley *In* NRL The Shock and Vibration Bull., No. 35, Pt. 3 Jan. 1966 p 187–205 refs (See N66-24020 13-32) CFSTI: HC $6.00/MF $1.50

The application of experimentally derived transfer functions to purely mechanical systems is investigated. The transfer function for a mechanical model, intended to represent a viscously damped, single-degree system, is experimentally derived by subjecting the mechanical model to steady-state, sinusoidal vibration, and utilizing the resulting Bode plots. This experimental transfer function is used to predict the transient response to a mechanical shock pulse. The suitability of this experimental transfer function is investigated by comparing the response with the theoretical response of the idealized system, and with the actual response of the model to a mechanical shock pulse. A discussion is presented on methods of improving the experimental transfer function by utilizing the amplitude and phase plots. Author

N66-24043# Navy Dept., Washington, D. C.
JOINTS USED IN PLASTIC AND COMPOSITE SHIPBOARD SUPERSTRUCTURES, DECKHOUSES, LIGHT BULKHEADS, AND ENCLOSURES [SOYEDINENIYA, PRIMENYAYEMYYE V PLASTMASSOVYKH I KOMPOZITNYKH KONSTRUKTSIYAKH SUDOVYKH NADSTROYEK, RUBOK, LEGKIKH PEREBOROK]
B. F. Prokhorov 1966 19 p Transl. into ENGLISH from Sudostroyeniye (Leningrad), no. 9, 1965 p 44–51 *Its* Transl. No. 2074-B
(TT66-60737; AD-629509) CFSTI: HC $1.00/MF $0.50

The joints used in plastic and composite superstructures, deckhouses, bulkheads and enclosures can be glued or fastened (bolts, screws, rivets) or they can be a combination of the two. A certain amount of caution should, however, be observed in using mechanical joints because of the well-known negative aspects of this method, and because of the characteristics of plastics. Foremost among the latter is the great sensitivity of plastic to notching and to impact (when riveted), and also susceptibility to creep. TAB

N66-24100# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLIED MECHANICS Selected Articles
19 Oct. 1965 31 p refs Transl. into ENGLISH from Prikl. Mekh. (Kiev), v. 10, no. 6, 1964 p 600–607, 632–639, 660–663
(FTD-TT-65-975/1+2+3+4; AD-625799) CFSTI: HC $2.00/MF $0.50

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N66-24101# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SYMMETRIC DEFORMATION OF A CONICAL SHELL, STIFFENED BY RIBS
O. O. Zhuravel' *In its* Appl. Mech. 19 Oct. 1965 p 1–11 refs (See N66-24100 13-32) CFSTI: HC $2.00/MF $0.50

Stretching and bending of a constantly thick conical shell, stiffened on one side by closely spaced meridional ribs, was investigated. It is pointed out that the effect of the ribs is smoothed in the circumferential direction; thus the problem reduces to an investigation of the deformation of a structurally orthotropic shell of revolution, whose elastic properties are determined with allowance for the effect of the ribs on shell rigidity. Geometrical smallness of shell deformation is assumed. D.T.

N66-24102# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STABILITY OF A CYLINDRICAL SHELL UNDER LONGITUDINAL IMPACT
V. I. Borysenko *In its* Appl. Mech. 19 Oct. 1965 p 12–22 refs (See N66-24100 13-32) CFSTI: HC $2.00/MF $0.50

The stability of a cylindrical shell, fixed at one end, under longitudinal impact by a rigid body was investigated. It was assumed that the stresses in the shell do not exceed the elastic limit; that the deformations are geometrically small; and that, at some time after impact, the shell is in a membrane stressed state described by $\delta^2 u_0/\delta\alpha^2 = \delta^2 u_0/\delta\tau^2$ with corresponding boundary and initial conditions. In order to account for the loss of stability in the portion of the shell adjacent to the impact end, the variational equations of perturbed motion were derived for that portion of the shell over which the longitudinal compression wave has already traveled. The equations obtained in the investigation were reduced to a system of ordinary differential equations. The displacements are represented by a series of fundamental functions whose types depend on the boundary conditions and on the matching of the disturbed portion of the shell with the undisturbed portion. The case of axisymmetric loss of stability, when the mass of the impacting body is infinitely large, is considered as an example. D.T.

N66-24103# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPROXIMATE CALCULATION OF LONGITUDINAL-RADIAL VIBRATIONS OF A SYSTEM OF CYLINDRICAL SHELLS, PARTIALLY FILLED WITH FLUID
M. O. Kil'chevskyy, M. P. Petrenko, D. V. Babych, and R. P. Barsuk *In its* Appl. Mech. 19 Oct. 1965 p 23–28 refs (See N66-24100 13-32) CFSTI: HC $2.00/MF $0.50

The longitudinal–radial vibrations of a system of cylindrical shells partially filled with fluid was investigated for the case of fluid potential motion; allowance was made for the elasticity of the shell bottom. The motion equations were derived using elasticity theory energy methods and the variational principles of analytical mechanics. In the numerical example considered, the effects of the fluid and of the shell bottom elasticity lead to a 63% decrease in the fundamental natural frequency. On the other hand, it is pointed out, the neglect of the radial displacement of the shell leads to an 18% increase in the fundamental frequency. D.T.

N66-24284# Chalmers Univ. of Technology, Goteborg (Sweden).
ISOSTATIC SUPPORT: NOTES ON EQUILIBRIUM, DISPLACEMENT, AND ISOSTATIC SUPPORT OF RIGID BODIES IN PLANE AND SPACE
Bengt Å. Åkesson 1965 36 p refs *Its* Trans. No. 302 CFSTI: HC $2.00/MF $0.50

The conditions for equilibrium of the bar-triangle and the bar-tetrahedron loaded at their joints and considered as rigid bodies, are analyzed. The existence of transversals of two, three, four, and more given straight lines in space is investigated. Knowledge of the existence of transversals of given lines of action of forces is demonstrated to be of importance when the equilibrium of loaded bodies in space is studied by means of moment equations. Arbitrary displacements of rigid bodies in plane and in space are discussed on a qualitative basis. Infinitesimal displacements are quantitatively treated by use of vector algebra in matrix form. The results regarding statics and kinematics are used to discuss and establish the conditions for isostatic support of rigid bodies in plane and in space. Author

N66-24359# Ballistic Research Labs., Aberdeen Proving Ground, Md.
SOLUTION OF TRANSIENT VIBRATION PROBLEMS BY SEPARATION OF VARIABLES
A. S. Elder *In* APL Proc. of the 4th Meeting, Tech. Panel on Solid Propellant Combustion Instability Apr. 1964 p 91–95 refs (See N66-24346 13-33) CFSTI: HC $4.00/MF $0.75

Equations of motion, stress strain relations, and vibrations are used for formulating characteristic equations for a torsional pendulum consisting of a viscoelastic rod fixed at $z = 0$ and attached to a rotating disc at $z = l$. Boundary conditions are given. When an attempt to formulate the corresponding characteristic equation for a viscoelastic solid is made, it is found that the variables in the boundary conditions cannot be separated unless the shear modulus is proportional to the bulk modulus. This, however, is not generally true of a viscoelastic solid, since the shear modulus decreases through several orders of magnitude while the bulk modulus varies through a narrow range. It was concluded that transient vibration problems in linear viscoelasticity can be solved by Sturm-Lioville methods provided the boundary conditions lead to a characteristic equation that has real roots only and does not involve the mechanical properties of the solid. I.S.

N66-24390*# Washington Univ., Seattle.
PHOTOVISCOELASTICITY
Ellis Harold Dill and Charless Fowlkes Washington, NASA May 1966 120 p refs
(Grant NsG-401)
(NASA-CR-444) CFSTI: HC $1.45/MF $0.75 CSCL 20K

This report provides a basis for the description of the mechanical and optical properties of birefringent, viscoelastic materials, and for the application of these materials in experimental stress analysis by photomechanics. The experimental procedure is applied to two plane stress problems. Preparation of the model, characterization of the material, and the test apparatus are also described. Author

N66-24392*# Astro Research Corp., Santa Barbara, Calif.
A SEMI-ATOMISTIC MODEL FOR FLAW-INDUCED FRACTURE IN NON-DUCTILE MATERIALS
H. Schuerch Washington, NASA, May 1966 33 p refs
(Contract NASw-652)
(NASA-CR-471) CFSTI: HC $2.00/MF $0.50 CSCL 20K

A semi-atomistic model is proposed for the non-ductile failure of materials based upon an analysis of static and dynamic stress concentrations in uniaxial fiber–matrix composite materials. An elementary, two-dimensional analysis based on linear force-displacement laws shows, that the stress concentration is dependent only upon the digital quantity of the number of adjacent, broken filaments or bonds, and is independent of the spacing and of the relative elastic properties of the fiber and matrix. The results of the elementary analysis are of sufficient significance to warrant extension of the theory to non-linear force elongation, and to account for temperature, stress corrosion and static fatigue effects. Author

N66-24411# Weapons Research Establishment, Salisbury (Australia).
THE EFFECTS OF TEMPERATURE AND CREEP ON THE FAILURE PRESSURES OF COMMERICALLY PURE ALUMINUM SHEARING DISCS UNDER HYDROSTATIC LOADING
B. E. Furby Dec. 1965 34 p refs
(CPD-106) CFSTI: HC $2.00/MF $0.50

An investigation was made into the effects of temperature and creep on the failure pressure of commercially pure aluminum shearing discs, subjected to hydrostatic loading by a stepwise increase of pressure which approximated to a constant rate of pressurization. It was found that temperature and creep both affect the failure pressure; about 0.2% decrease per degree centigrade rise in temperature and as much as 10% decrease due to creep. Author

N66-24427# Lockheed Missiles and Space Co., Sunnyvale, Calif.
TRANSIENT IN A LINEAR SYSTEM UNDER THE EFFECT OF RANDOM FORCES
A. N. Golubentsev and S. S. Reznik (1966) 4 p refs Transl. into ENGLISH from Prikl. Mekh. (USSR), v. 2, no. 2, 1966 p 100–103

The motion of a mechanical system subject to the differential equation $Ly=x(t)$, where $x(t)$ is a random non-stationary function of the time, is considered herein. Formulas are presented to determine the mathematical expectation and the correlation function of the random process $x(t)$. The inhomogeneous operator $Ly=x(t)$ is reduced to the homogeneous operator $Ly=0$ with random initial conditions. Formulas are determined to find the mathematical expectation and correlation function of the initial random conditions. The connection is shown between the statistical characteristics of $y(t)$ and the statistical characteristics of the initial conditions. Author

N66-24435# Hayes International Corp., Birmingham, Ala.
INVESTIGATION OF NONLINEAR STRUCTURAL FEEDBACK IN BOOSTER CONTROL SYSTEMS
Victor E. Morrow, B. D. Liaw, and William D. Peeples, Jr. 22 Dec. 1965 101 p refs *Its* Eng. Rept.-1215

A technique for deriving nonlinear bending equations of motion for use in analog simulation was developed to study the effects of structural nonlinearities on the control system. Two alternate procedures for deriving the equations are presented: one uses the Lagrange equation and a set of distributed generalized coordinates which are the normal coordinates of the linear bending equation; the other is based on the Ritz averaging method for obtaining approximate analytical solutions to nonlinear vibration problems. The method is applied specifically to the case of a nonlinear stress–strain relationship given by the linear combination of a first order and a cubic term. The bending equations are modified for use in simulating the vehicle flight dynamics and control system; this involves a reformulation of one equation to include the effects of shear and rotary inertia. Studies on a lumped parameter method are also reported, and a brief review of a literature survey is included. M.G.J.

N66-24468# Brown Univ., Providence, R. I. Div. of Engineering.
CONTAINED PLASTIC DEFORMATION NEAR CRACKS AND NOTCHES UNDER LONGITUDINAL SHEAR
James R. Rice Jul. 1965 50 p refs

An exact linear elastic–perfectly plastic solution is presented for the problem of a sharp notch (or, when the notch angle is zero, a crack) in a plane of finite width subjected to anti-plane stresses inducing a stress and deformation state of longitudinal shear. General solutions for physical coordinates corresponding to given stresses, position of the elastic–plastic boundary, and accompanying displacements are given in terms of finite single integrals. The case of cracks is treated in detail and closed form solutions are presented in terms of elementary and elliptic functions. Numerical results are given and applications of the solution to the development of fracture mechanics failure criteria, as well as some inherent difficulties, are discussed. Author

N66-24491*# Hayes International Corp., Birmingham, Ala.
INVESTIGATION OF LATERAL ACCELERATION-BENDING COUPLING FOR A LARGE BOOSTER UTILIZING MULTI ACCELEROMETERS
J. E. Bailey, S. R. Mc Waters, and Morris Frimer 22 Dec. 1965 56 p refs *Its* Eng. Rept.-1213
(Contract NAS8-20201)
(NASA-CR-74551) CFSTI: HC $3.00/MF $0.50 CSCL 20K

A method for analyzing lateral acceleration-bending coupling in a large flexible booster is studied to obtain a simplified frequency domain analysis method which will aid in positioning multiple accelerometers. This analysis technique is an attempt to gain basic insight into the problem of positioning multiple accelerometers by defining a lateral-acceleration-bending filter function that depends on accelerometer position and number. The filter function amplitude and phase characteristic is varied by positioning the accelerometers. Straightforward application of Nyquist criteria permits determination of the stability of the uncoupled bending-lateral acceleration loop. Trends in overall system stability are indicated by this technique as shown by comparison with root locus studies. The method developed herein requires much less digital computer run time than comparable root locus studies and is applied to several familiar problems. Author

N66-24512*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

A NOTE ON BOUNDARY-CONDITION SIMULATION IN THE DYNAMIC TESTING OF SPACECRAFT STRUCTURE

W. H. Gayman 15 Apr. 1966 22 p refs

(Contract NAS7-100)

(NASA-CR-74655; JPL-TR-32-938) CFSTI: HC $1.00/MF $0.50 CSCL 20K

A common practice of subjecting an entire spacecraft to a sine-sweep environmental vibration test is examined in the light of the actual boundary conditions prevailing at the interface of the spacecraft and its launch vehicle. By recourse to some simple experiments, it is shown that the conventional sine-sweep test is not only inappropriate as a structural test, but also may provide either an overly severe or an unconservative test of certain subassemblies or assemblies. Recommendations are made for fuller utilization of dynamic-response analyses that treat the flexible spacecraft as an integral part of the flexible space vehicle system. It is concluded that such analyses can aid the acquisition and interpretation of structural flight test data and, also, establish the nature of the required structural qualification testing. Author

N66-24592*# Northwestern Univ., Evanston, Ill. Structural Mechanics Lab.

ENERGY CONSIDERATIONS IN THE ANALYSIS OF STABILITY OF NON-CONSERVATIVE STRUCTURAL SYSTEMS

G. Herrmann and S. Nemat-Nasser Dec. 1965 28 p refs *Its* Tech. Rept.-65-5

(Grant NsG-605)

(NASA-CR-74624) CFSTI: HC $2.00/MF $0.50 CSCL 20K

Energy considerations are introduced into the analysis of discrete, linear structural systems subjected to nonconservative (circulatory) forces. Various formulations of energy balance permit stability criteria establishment and insight into several features associated with the stability of nonconservative systems, e.g. the destabilizing effect of damping and gyroscopic forces. A simple example is used to illustrate the general considerations. Author

N66-24655# Goodyear Aerospace Corp., Akron, Ohio.

MATERIALS AND FABRICATION TECHNIQUE INVESTIGATION—EXPANDABLE MODULES FOR LUNAR SURFACE OPERATIONS (STEM) Summary Report

K. L. Cordier 29 Jan. 1965 37 p

(SP-3783)

Described herein is a composite material construction selected as most suitable for the shelter and airlock structure in the lunar environment. The candidate composite wall construction provides materials that have exceptionally good properties of low specific weight (0.64 lbs/sq. ft.), impermeability to gases, resistance to solar and ultra-violet degradation, low surface vaporization due to the effect of a space vacuum and all of which are non-toxic. Based on this investigation, polymeric type films, foams, fibers and elastomer materials, and certain ferrous and non-ferrous type materials, have been selected for construction of a demonstration module of the STEM shelter and airlock composite structure. To demonstrate fabrication techniques, test specimens of the recommended composite structure have been constructed for evaluation and also for qualification testing. Author

N66-24673# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Labs.

A REVIEW OF ANALYTICAL METHODS USED TO DETERMINE THE MODAL CHARACTERISTICS OF CYLINDRICAL SHELLS

Kevin Forsberg May 1965 75 p refs Presented at the 7th Intern. Aeron. Congr., Paris, 14–17 Jun. 1965

(LMSC-6-75-65-25)

Results obtained by energy and finite difference techniques, as well as exact solutions for simplified (Donnell) differential equations, are compared. The effect of omitting inplane inertia is also examined. The comparisons are made on the basis of natural frequency, mode shape, and modal force distribution, and an indication is given of the time required for solution by the different methods on a high-speed digital computer. Author

N66-24708# Lehigh Univ., Bethlehem, Pa. Fritz Engineering Lab.

STIFFENED PANELS AND WELDING CONTINUOUS FRAMES Final Report, Oct. 1, 1964–Sep. 30, 1965

25 Feb. 1966 6 p refs

(Contract NObs-90041)

(Rept.-248/273.3; AD-628978) CFSTI: HC $1.00/MF $0.50

An investigation was made of the plastic strength of indeterminate steel structures and the study of the plastic behavior of the component parts of such structures. A special protion of the work has been an investigation of the strength of longitudinal stiffened plate panels. TAB

N66-24741# IIT Research Inst., Chicago, Ill. Technology Center.

EXPERIMENTAL STUDY OF STRESS WAVE INTERACTION IN PHOTOVISCOELASTIC PLATES Technical Report, 1 Oct. 1963–5 Feb. 1965

I. M. Daniel Kirtland AFB, N. Mex., AFWL Jan. 1966 200 p refs

(AFWL-TR-65-43; AD-628806) CFSTI: HC $5.00/MF $1.25

The objective of this investigation is to obtain experimental solutions to viscoelastic stress wave interaction problems pertinent to the design of protective structures. The methods of photoviscoelasticity and experimental viscoelasticity in general were employed. The model material used, plasticized polyvinyl chloride, was characterized mechanically and optically by creep tests at different temperatures using the temperature-time equivalence principal and by sinusoidal oscillation tests. Good agreement was obtained by the two methods of property determination. Photoviscoelastic plates were subjected to falling weight and air shock loadings. In the falling weight loading stresses were determined on the boundary of a circular hole and at a similarly located point in the free field. It was found that the measured maximum compressive stress on the hole boundary is up to 17 percent higher than that obtained by using the free-field stresses and static stress concentration factors. In the air shock loading, stresses were determined at a free-field point and on the boundaries of a circular hole and a rigid circular inclusion. The maximum compressive stress on the hole boundary is appreciably higher than the statically computed stress initially, but approaches it at later times. In the case of the rigid inclusion, differences of up to 25 percent between dynamic and static stresses were found. Author (TAB

N66-24749# Brown Univ., Providence, R. I. Div. of Engineering.

PLASTIC YIELDING AT A CRACK TIP

James R. Rice Mar. 1965 46 p refs

A model is proposed for studying the influence of plastic yielding on the stress and deformation near the tip of a through-the-thickness crack in an elastic plane. General methods of solution for the deformation and stress distribution are given for a class of cracked plates under loadings inducing a state of plane strain or generalized plane stress. Du

of the principal results is that for cases in which the size of the zone of plastic deformation at the crack tip is negligible in comparison with geometric dimensions of the cracked body, the stress and deformation near the crack tip are determined solely by the elastic stress intensity factor. Solutions are given for unloading and cyclic loading, where a similar dependence on the stress intensity factor is indicated for small scale yielding. Implications for the criteria of fracture at a crack tip and for fatigue crack propagation are discussed, and methods of correcting predictions based on an elastic analysis to account for the influence of large scale yielding are presented. Author

N68-24750# Brown Univ., Providence, R. I. Div. of Engineering.

STRESSES DUE TO A SHARP NOTCH IN A WORK HARDENING ELASTIC–PLASTIC MATERIAL LOADED BY LONGITUDINAL SHEAR

James R. Rice Dec. 1965 66 p refs
(Grant NSF GK-286)

A work hardening elastic-plastic stress analysis is presented for a sharp notch or, as a limiting case, a crack perturbing a remotely applied uniform stress field. Mathematical complexities are reduced by considering the kinematically simple case of anti-plane longitudinal shear deformations and by employing a deformation plasticity theory rather than the more appropriate incremental theory. Consequently, a general solution is valid for any relation between stress and strain in the work hardening range, as long as the remotely applied stress does not exceed the initial yield stress. When a power law relates stress to strain in the work hardening range, the deformation theory solution is also the correct incremental solution at low applied stress levels causing yielding on a scale small compared to notch depth. For cracks, the near crack tip strain field is shown to depend on loads and geometry only through the elastic stress intensity factor when yielding is on a small scale, and the elastic-plastic boundary and lines of constant strain magnitude are circles. Extensive numerical results are tabulated for a crack, 45°V notch, and 90° V notch in power law hardening materials. Author

N68-24763# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

A COMPARATIVE STUDY OF LIFTING BODY HEAT SHIELD AND STRUCTURAL CONCEPTS

R. Johnson, Jr. Nov. 1965 113 p refs
(SM-47855)

Data concerning design loads, design criteria, structural and thermal shield approaches, and weight comparisons of several integrated structural and thermal protection systems are presented for assisting the evaluation of structural and thermal systems for manned lifting entry vehicles. Two design approaches are examined: (1) a double wall design, in which the ablator is bonded to an outer shell, and (2) a single wall design, in which the ablator is bonded to the outer surface of a single shell that serves as the pressure shell and load-carrying structure. The design work utilized prior work done with a 28-ft HL-10 lifting entry vehicle configuration used for studying structural and ablative shield design concepts and weights. L.S.

N68-24796# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

SOME NEW RESULTS FROM RESEARCH ON THE BUCKLING OF CYLINDRICAL SHELLS [QUELQUES NOUVEAUX RESULTATS DE RECHERCHES SUR LE FLAMBAGE DES COQUES CYLINDRIQUES]

Nicholas J. Hoff May 1965 52 p refs In FRENCH
(Contract AF 49(638)-1276)
(SUDAER-240; AFOSR-660085; AD-628925) CFSTI: HC $5.60/MF $0.50

Recent results for cylindrical shell buckling under uniformly distributed axial compression are reviewed. Based on the results an analysis was performed of a semi-infinite shell with nonrigid support. In addition, the theory of large displacements is discussed, along with the significance of an equilibrium state with large displacements. A bibliography of recent publications on shell theory is included. Transl. by D.T.

N68-24909*# National Aeronautics and Space Administration, Washington, D. C.

ELASTIC CONSTANTS AND THERMAL EXPANSION OF CERTAIN BODIES WITH A NONHOMOGENEOUS REGULAR STRUCTURE [UPRUGIYE POSTOYANNYYE I TEPLOVOYE RASSHIRENIYE NEKOTORYKH TEL S NEODNORODNOY REGULYARNOY STRUKTUROY]

G. A. Van Fo Fy Mar. 1966 11 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 166, no. 4, 1966 p 817–820
(NASA-TT-F-10048) CFSTI: HC $1.00/MF $0.50 CSCL 20K

A method is presented for determining elastic constants and thermal expansion coefficients of nonhomogeneous bodies. The equations derived may be employed to obtain the formulas for the constants for orthorhombic, tetragonal, and hexagonal structures. They also facilitate a determination of the physico-mechanical characteristics and the stress state of synthetic materials such as plastic glass, in which the binder has elastic, viscous properties. Author

N68-24933*# Michigan Univ., Ann Arbor.

SIMPLE APPROXIMATIONS FOR FORCE-DEFLECTION CHARACTERISTICS OF AIRCRAFT TIRES

Samuel K. Clark Washington, NASA, May 1966 71 p refs
(Grant NsG-344)
(NASA-CR-439) CFSTI: HC $3.00/MF $0.75 CSCL 20K

Simplified expressions are derived for three of the more commonly used force-deflection characteristics of aircraft tires in terms of tire size and inflation pressure. These are the vertical load-vertical deflection, side load-side deflection and torsional moment-angle of twist relationships. The derivations are based on the concept of treating the tire as a pressurized torus of circular cross-section with no bending rigidity, and on the concept of treating the outer portion of the tire, or "running band" as a string on an elastic foundation. Predictions from such simplified theories are compared with extensive experimental data obtained by N.A.C.A. in 1953, and agreement is generally good although far from perfect. The primary usefulness of such expressions probably lies in the area of preliminary design, where extensive parametric studies are often required to optimize response under many different input conditions. They may also be of use in ground vibration studies of aircraft. Author

N68-24960*# Texas A&M Univ., College Station. Space Technology Div.

THE ANALYSIS OF STRUCTURALLY ORTHOTROPIC SHELLS BY MEANS OF THE COMPLIANCE METHOD

Thomas J. Kozik 1 May 1966 15 p
(Grant NGR-44-001-031)
(NASA-CR-74737) CFSTI: HC $1.00/MF $0.50 CSCL 20K

Progress is reported on the problem of approximating the behavior of the structurally orthotropic shell by finding the correlation or compliance between the elastic constants of

the unstiffened shell and the effects of stiffeners of the structurally orthotropic shell. To this end, the first order differential equations for an orthotropic shell were derived. Results indicated that this theory was unsatisfactory in predicting behavior of an intrinsically orthotropic shell. Prior to deriving second order theory for orthotropic shells, second order isotropic shell equations were studied and tracer parameters were used to evaluate shear effects. A study was made of stiffened plates to determine whether techniques of plate analysis could be applied to stiffened shells. However it was found that no compliance technique existed where the elastic constants of an intrinsically orthotropic plate are related to the stiffener effects. E.A.O.

N66-24962*# Lockheed Missiles and Space Co., Huntsville, Ala. Huntsville Research and Engineering Center.

WEIGHT-SAVING THROUGH USE OF BERYLLIUM-ALUMINUM ALLOYS FOR SATURN-TYPE VEHICLE STRUCTURES Final Report, 24 Apr. 1965–24 Mar. 1966

H. H. Armstrong Mar. 1966 178 p refs
(Contract NAS8-11298)
(NASA-CR-74788; LMSC/HREC-A782443; HREC/1298-2)
CFSTI: HC $5.00/MF $1.00 CSCL 22D

A comparison of material properties of conventional light weight metals indicates beryllium-aluminum alloys offer potential weight savings of 50 to 70 percent for compression-loaded primary structures. The premise that beryllium-aluminum alloys with a modulus of elasticity equal to steel, yet weighing one-fourth as much as steel, could save 50% of the weight of a Saturn-type upper-stage structure is investigated and confirmed. In addition, hardware costs, costs per pound, and net cost savings per launch are considered. It is shown that the case for 50% weight savings through beryllium-aluminum alloys can be accomplished at a cost of only $240 per pound of weight saved, a very competitive figure in view of the high cost of payloads (up to $10,000 per pound). Cylindrical interstages 22 feet in diameter, loaded by a uniformly distributed axial load typical of a Saturn V upper-stage, were optimized structurally for minimum weight. Digital computer programs were used to optimize automatically the stiffened constructions, consistent with manufacturing restraints deemed advisable. The materials investigated included unalloyed beryllium, beryllium-aluminum alloys, and alloys of titanium, aluminum and magnesium. Constructions considered included integral stiffeners, conventional flanged open sections, and corrugation-type closed sections. Author

N66-24979*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.

WEIGHT-SAVING THROUGH USE OF BERYLLIUM-ALUMINUM ALLOYS FOR SATURN-TYPE VEHICLE STRUCTURES

H. H. Armstrong Dec. 1965 170 p refs
(Contract NAS8-11298)
(NASA-CR-74674; HREC/1298-1; LMSC/HREC-A712431)
CFSTI: HC $5.00/MF $1.00 CSCL 22D

A comparison of material properties of conventional light weight metals indicates beryllium-aluminum alloys offer potential weight savings of 50 to 70 percent for compression-loaded primary structures. The premise that beryllium-aluminum alloys with a modulus of elasticity equal to steel, yet weighing one-fourth as much as steel, could save 50% of the weight of a Saturn-type upper-stage structure is investigated and confirmed. Additionally, hardware costs, costs per pound, and net cost savings per launch are considered. Cylindrical interstages, 22 feet in diameter, loaded by a uniformly distributed axial load typical of a Saturn V upper-stage were optimized structurally for minimum weight. Digital computer programs were used to optimize automatically the stiffened constructions, consistent with manufacturing restraints deemed advisable. The materials investigated included unalloyed beryllium, beryllium-aluminum alloys, and alloys of titanium, aluminum and magnesium. Constructions considered included integral stiffeners conventional flanged open sections, and corrugation-type closed sections. Author

N66-24983*# Allied Research Associates, Inc., Concord, Mass.

MINIMUM WEIGHT DESIGN OF SYMMETRICALLY STIFFENED ORTHOTROPIC CYLINDERS UNDER AXIAL COMPRESSION

George Gerard and C. Lakshmikantham 30 Mar. 1966 69 p refs *Its* Tech. Rept.-292-2
(Contract NASw-1174)
(NASA-CR-74667) CFSTI: HC $3.00/MF $0.75 CSCL 20K

The historical development and current status of compressive orthotropic stability theory is reviewed and a systematic development of the linear theory is presented. Available test data on orthotropically stiffened cylinders are synthesized and correlated in terms of this theory. The correlation was used to establish regions in which linear orthotropic theory appears to be valid in terms of currently available test data. Within the restriction that the minimum weight analysis be confined to those regions where linear stability theory is valid, a generalized presentation for symmetrically stiffened orthotropic cylinders under compression was developed. Similarities and differences in the minimum weight behavior of stiffened cylindrical shells and flat transversely stiffened wide columns were investigated in some detail to provide a satisfactory physical picture. The concluding results provide a comparative evaluation of various forms of stiffening systems for cylindrial shells under compression. Author

N66-25023*# National Aeronautics and Space Administration, Washington, D. C.

ON THE STATE OF STRESS NEAR CURVILINEAR HOLES IN SHELLS [O NAPRYAZHENNOM SOSTOYANII OKOLO KRIVOLINEYNYKH OTVERSTIY V OBOLOCHKAKH]

G. N. Savin and A. N. Guz' Washington, NASA, May 1966 16 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), v. 7, no. 6, 1964 p 96–105
(NASA-TT-F-423) CFSTI: HC $1.00/MF $0.50 CSCL 20K

The investigation of stress concentrations near holes in shells is reduced to the solution of boundary value problems in which the variables are not separated either in the solving equations or in the boundary conditions. An exception to this is the spherical shell with a circular hole and a cylindrical shell with a small circular hole. As a result of this situation it is not possible to obtain an accurate solution of the problem for other hole shapes. The present work proposes an approximate method of investigating the state of stress in shells near curvilinear holes of arbitrary shape based on the method of perturbed boundary form. By applying the method we obtain a sequence of boundary value problems for a circular hole. In the case of a spherical shell with large holes and in case of cylindrical shells weakened with small holes, we are led to problems in which the variables are separable when holes are of arbitrary shape but do not contain angular points. Author

N66-25024*# National Aeronautics and Space Administration, Washington, D. C.

THE STRESSED STATE NEAR CURVILINEAR REINFORCED ORIFICES IN SHELLS [O NAPRYAZHENNOM SOSTOYANII OKOLO KRIVOLINEYNYKH PODKREPLENNYKH OTVERSTIV V OBOLOCHKAKH]

A. N. Guz' and G. N. Savin May 1966 11 p refs Transl. into ENGLISH from Inzh. Zh. (USSR), v. 5, no. 1, 1965 p 103-109
(NASA-TT-F-424) CFSTI: HC $1.00/MF $0.50 CSCL 20K

An approximation method was used to investigate the state of stress in shells near curvilinear holes supported by thin elastic rings which resist tension, flexure, and torsion. The case of a spherical shell loaded with a uniform internal pressure and weakened by an elliptical orifice with small eccentricity was considered. D.T.

N66-25161*# Northrop Corp., Hawthorne, Calif.
EVALUATION OF SELF-SEALING STRUCTURES FOR SPACE VEHICLE APPLICATION
Philip J. D'Anna and Roger M. Heitz Washington, NASA, May 1966 102 p refs
(Contract NASr-102)
(NASA-CR-485) CFSTI: HC $3.00/MF $0.75 CSCL 22B

Investigations were conducted to determine the feasibility of using a self sealing wall for ensuring the sealed integrity of pressurized space vehicle compartments in a micrometeorite environment. It is reported that experimental verification of the feasibility of this concept has been achieved with simulated space vehicle multi-sheet wall structures incorporating either mechanical, chemical or combined mechanical-chemical self sealing techniques. Two basic self sealing wall configurations evolved from the investigations. The integral system concept incorporates the self sealing feature into the space between the inner and outer shell of an aluminum structural wall. The sealing action is achieved at the outer shell where impact damage is minimal and sealing more easily effected. In the tile concept, the self sealing feature is incorporated into a nonmetallic open face tile which is then bonded to the inner shell of a double face sheet wall structure. The sealing action in this concept is accomplished at the inner shell of the basic wall structure. The ballistic tests that were conducted to evaluate penetration resistance of multi-sheet wall structures are described in detail and the conclusions drawn from these studies are listed. H.S.W.

N66-25255# Lockheed Missiles and Space Co. Sunnyvale, Calif.
STABILITY OF A CLOSED CYLINDRICAL ORTHOTROPIC FLEXIBLE SHELL TAKING ACCOUNT OF LINEAR HEREDITY
M. A. Koltunov and A. El-Kurmani [1965] 11 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. I: Mat. i Mekhan. (Moscow), no. 2, 1966 p 112-120

Consideration is given to the stability of an axially compressed closed circular cylindrical shell fabricated from orthotropic glass-plastic with a reinforcing linen fabric interweaving. The solution method takes linear heredity into account, and comparisons of the critical loadings are made with elastic solutions. It is noted that the critical loadings of shells whose material possesses linear heredity depend essentially on the loading regimes, and increase as the loading rate increases. C.T.C.

N66-25259# General Dynamics/Convair, San Diego, Calif.
NON-LINEAR ANALYSIS OF AXISYMMETRICALLY LOADED ORTHOTROPIC SHELLS OF REVOLUTION
R. W. Schwarz 15 Dec. 1965 93 p refs
(GD/C-EER-AN-776)

The non-linear interaction between the meridional stress resultant and rotation is considered in discontinuity regions of highly strained thin shell structures. The non-linear interaction is handled by the addition of appropriate terms to the basic shell equilibrium equations. The equilibrium equations are then combined with the necessary strain-displacement and stress-strain relationships resulting in the formation of six first order differential equations. The equations are then specialized for particular shells of revolution; including spheres, cylinders, cones and ellipsoids. The equations are solved by means of the Runge-Kutta method and the results are used to form a stiffness matrix for the shell segment in question. The procedure is repeated for each segment of the discontinuity region. Standard matrix techniques are used to solve the discontinuity problem. The analysis is designed to handle orthotropic materials, temperature gradients within the shell wall, varying thicknesses and loading conditions as well as non-linear effects. Author

N66-25283# Rhodes and Bloxsom, Canoga Park, Calif.
CALIBRATIONS OF RHODES AND BLOXSOM MICROMETEORITE ACCELERATOR 14.1 TO 36.4 KM/SEC
1 Aug. 1964 30 p refs

A carbon microparticle mix was accelerated to 14.1 km/sec in order to calibrate the electric discharge micrometeorite gun. The density and number distribution of the carbon particle mix correspond closely with expected micrometeorite values in close earth orbits. The calibration was tested against a micrometeorite detecter variously covered with 1 mil thick aluminum, 7.5 mil thick steel, and 1 in. thick, 2.3 lb/ft^3 styrofoam. The results are given both for the 14.1 km/sec velocity and 27 km/sec velocity. The limit of the microparticle accelerator is 84 km/sec; and the calibration of mass vs velocity is given as 36.4 km/sec at 6.7×10^{-6} gm. D.T.

N66-25287# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
AN INVESTIGATION OF CREEP BENDING CHARACTERISTICS OF LINEAR POLYMER COLUMN INFLUENCED BY NON-UNIFORM THERMAL ENVIRONMENTS
Akira Kobayashi Feb. 1966 21 p refs
(ISAS-401, vol. 30, no. 2) CFSTI: HC $1.00/mf $0.50

The creep bending characteristics such as the lateral creep deflection versus time relations are investigated in the nonuniform thermal environments for the linear polymer column having the idealized section. The linear polymer is described as a combination of Maxwell and Voigt elements. The nonuniform temperature distributions alongside the column length are assumed to be the idealized stepwise profile. The temperature dependence is expressed in terms of rate process appeared in the viscosity term. The numerical example for polymethylmethacrylate, whose physical properties are obtained through the usual tensile creep test, shows the conspicuous effects due to nonuniformity in the temperature distribution. Author

N66-25294# Lockheed Missiles and Space Co., Sunnyvale, Calif.
VIBRATIONS AND STABILITY OF A CYLINDRICAL SHELL IN A GAS FLOW
A. D. Brusilovskii, L. M. Mel'nikova, and Iu. Iu. Shveiko [1966] 14 p refs Transl. into ENGLISH from Inzh. Zh. (USSR), no. 1, 1966 p 67-73

This paper uses the exact solution of a system of perturbed motion equations for a shell in displacements taking account of all the inertial force components to calculate the critical flutter velocities for an elastic circular cylindrical finite shell. The aerodynamic forces were determined by means of piston theory. The initial stress resultants in the shell middle surface were not considered. A shell with freely supported and fixed endplates is used as an illustrative example. R.N.A.

N66-25299# Brown Univ., Providence, R. I. Div. of Engineering.
A GRAIN BOUNDARY MODEL FOR POLYCRYSTALS AND SINTERED CARBIDES Technical Report No. 20
R. H. Hawley and W. R. Powell Mar. 1966 32 p refs
(Contract AT(30-1)-2394)
(NYO-2394-20)

Experimental verification is given for the predicted action of a model depicting polycrystalline or sintered carbide systems under stress as proposed by Drucker. The models employed consisted of a regular array of hexagonal bars of aluminum separated by asphalt "cement" layers of uniform thickness throughout. Construction of the models as well as the methods used to determine the viscoelastic properties of the asphalt are described in detail. The results of a series of creep tests, each at a constant load, are compared with the predicted behavior. Author

N66-25381# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
ON SAINT-VENANT'S PRINCIPLE AND THE TORSION OF SOLIDS OF REVOLUTION
James K. Knowles and Eli Sternberg Feb. 1966 37 p refs
(Contract Nonr-220(58))
(TR-5; AD-630291) CFSTI: HC $3.60/MF $0.50

This report contains a quantitative study of Saint Venant's principle within the context of the pure axisymmetric torsion of bodies of revolution in classical elastostatics. Explicit estimates are established for the decay of the strain energy and of the internal stresses produced by a self-equilibrated axisymmetric torsional loading applied to one end of the body in the absence of other loads. Both solid and hollow (shell shaped) bodies are treated. For the latter the decay in the mean twist is also estimated. Author (TAB)

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N66-23915# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FLAME PROPAGATION UNDER CONDITIONS OF AN IGNITION PENINSULA OF HYDROGEN–OXYGEN MIXTURES
V. Ya. Basevich and S. M. Kogarko 21 Oct. 1965 19 p refs
(FTD-TT-65-919/1+2+4; AD-628306) CFSTI: HC $1.60/MF $0.50

Hydrogen-oxygen flames were investigated under conditions, when in the combustion zone temperatures and pressures are realized, corresponding to an ignition peninsula. It appears possible to use the well-known mechanism of chemical reactions and velocity constants for kinetic calculation of flame propagation. Calculations were carried out on an electronic computer and showed that, at proper selection reaction rate constants, the experiment can be described with great accuracy. Selection of values of process rate constants $H+O_2+M_6 \rightarrow HO_2+M$ very strongly affects the calculation results, so that from comparing the results of calculations and experiment its value can be derived. Author (TAB)

N66-23944# Cambridge Univ. (England). Cavendish Lab.
GROWTH OF BURNING TO DETONATION IN LIQUIDS AND SOLIDS Annual Summary Report No. 8, Nov. 1964–Nov. 1965
F. P. Bowden Nov. 1965 8 p refs
(Grant AF-EOAR-65-24)
(AFOSR-66-0406; AD-628915) CFSTI: HC $1.10/MF $0.50

A high-speed photographic study was made of the initiation of explosive liquids (using sparks and impact) and of single crystals of explosive solids (using shock and hot wires). The physical homogeneity of the material was shown to have a marked effect on its sensitivity. Studies of the fracture of inert solids demonstrated the importance of geometry on the fragmentation process. Various branches of classical explosion theory were extended. Author (TAB)

N66-23949# Utah Univ., Salt Lake City. Dept. of Metallurgy.
INFLUENCE OF ELECTRICAL FIELDS ON SHOCK OF DETONATION TRANSITION
Melvin A. Cook and Tim Z. Gwyther 28 Sep. 1965 15 p refs
(Grant AF-AFOSR-56-65)
(AFOSR-65-2653; AD-629239) CFSTI: HC $1.00/MF $0.50

The prediction that one should be able to influence detonations in condensed explosives as well as gaseous ones by means of axial electric fields is studied by means of the deflagration to detonation transition (DDT) in a modified card gap (or SPHF plate) test by observing the influence of an applied field on the distance S_2 into the receptor where the DDT occurs. This distance S_2 for composition B was shown to be appreciably influenced by an applied electrical field. The magnitude of the effect in 2 in. diameter cast composition B (donor and receptor) and nearly a 5 cm lucite SPHF plate was about 0.15mm/kv/cm, a positive to negative potential increasing the distance S_2 and a negative to positive one decreasing S_2 (unless the DDT occurs too close to an electrode). Author

N66-23952# RAND Corp., Santa Monica, Calif.
INVARIANT IMBEDDING AND THE SOLUTION OF DIFFUSION EQUATIONS
Brian Gluss Feb. 1966 14 p refs
(Contract AF 49(638)-1700; Proj. RAND)
(RM-4931-PR; AD-629169) CFSTI: HC $1.60/MF $0.50

In this memorandum, invariant imbedding techniques are shown to be applicable to the numerical solution of a heat equation for an inhomogeneous rod, whose straightforward solution can be computationally unstable. This is done by taking the Laplace transform of the equation, which is itself unstable, and then deriving corresponding invariant imbedding equations. Author (TAB)

N66-23978# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
RESEARCH ON SOLID PROPELLANT COMBUSTION INSTABILITY Final Summary Report, 1 Jan.–30 Sep. 1964
R. H. Woodward Waesche and Martin Summerfield Feb. 1966 31 p refs *Its* Aeron. Eng. Rept.-766
(Grant AF-AFOSR-448-63; ARPA Order 317-62)
(AFOSR-66-0578; AD-629585) CFSTI: HC $3.60/MF $0.50

A search was made for predicted temperature waves using a 2-inch diameter T-burner as the source of oscillating pressure, in order to confirm the observations of Wood (9th Symposium on Combustion, p. 335, 1963); and then to measure the pertinent parameters, namely temperature, amplitude and phase. Unfortunately, no waves of the predicted type were found. However, waves similar to those of Wood were observed reproducibly when burning was allowed on the sides

of an uninhibited test sample, i.e., in a non-one-dimensional situation, but even so these waves were much weaker than the temperature variations that were expected. Various reasons for the non-occurrence of the expected temperature waves are considered. The most likely explanation is that the model of the gas phase reaction zone originally assumed, namely, a thin one-stage reaction zone is partially in error. Instead, it appears that the gaseous zone may be composed of two portions a thin primary zone near the surface needed in order to account for the observed burning rates, and a diffuse afterburning zone where the combustion reactions go to completion. Such a spread in the reaction zone would imply a longer total reaction. TAB

N66-23984# Trinity Coll., Dublin (Ireland). Engineering School.

MECHANICAL VIBRATION: A DRIVING MECHANISM FOR COMBUSTION INSTABILITY IN ROCKET ENGINES

P. D. Mc Cormack, David Cochrane, and L. Crane Nov. 1965 32 p refs

(Grant AF-EOAR-65-43)

(AFOSR-66-0404; AD-628920) CFSTI: HC $3.60/MF $0.50

The mixing and burning of gas/air jets in the presence of mechanical vibration of the injector was studied. Initial photographic Schlieren and spectroscopic observations of a H_2/air and coal gas/air flame vibration conditions have been carried out. The vibration obviously enhances the rate of mixing and higher mean flame temperatures result. A closed solution was obtained for the case of a vibrated gas jet mixing with its surroundings, in the nearfield (potential core) region. Generally speaking, the theory predicted that the vibration, treated as a source of vorticity, would raise the mean axial component of velocity at any point inside the mixing region. This was verified by a hot-wire anemometer investigation. Furthermore, it was established that the vibration drives the vortex shedding mechanism in the flow from an orifice. Author

N66-23986# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

JOURNAL OF ENGINEERING PHYSICS Selected Articles

3 Jan. 1966 57 p refs Transl. into ENGLISH from Inzhenerno-Fiz. Zh. (Minsk), v. 7, no. 12, 1964 p 23-31, 60-65, 85-105

(FTD-TT-65-1257/1+2; TT-66-60371; AD-627112) CFSTI: HC $3.00/MF $0.50

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N66-23987# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MEASUREMENT OF SEMICONDUCTOR THERMAL CONDUCTIVITY BY A NONSTEADY PROBE METHOD

B. M. Mogilevskiy and A. F. Chudnovskiy *In its* J. of Eng. Phys. 3 Jan. 1966 p 1-15 refs (See N66-23986 13-33) CFSTI: HC $3.00/MF $0.50

Thermal conductivity of solid and particularly liquid semiconductors in regions of high temperatures were studied by the coaxial cylinder method. For this observational system, the heater was encased in an insulated sheath housing a thermocouple, the probe and specimen exhibited finite length, and the sample material was contained in a vessel with finite inside and outside radii. Thus, a concept of the equivalent coefficient of thermal conductivity greater than the true coefficient was introduced as a result of convected heat transfer. Evaluation of experimental data obtained on InSb, Bi_2Te_3, ZnSb, In_2Te_3, V_2O_5, Se, S, and AgI established the measurement error of the absolute magnitude of λ_2 when $\lambda_2 >$ 4-6 watt/m-deg within ±15-20%; when $\lambda_2 <$ 4 watt/m-deg the error was reduced to ±10%. G.G.

N66-23988# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ERRORS IN THE MEASUREMENT OF TEMPERATURE AT THE SURFACE OF A SOLID BY MEANS OF A THERMOCOUPLE IN THE CASE OF HEATING AND COOLING IN ACCORDANCE WITH AN ARBITRARY LAW

B. I. Makarov *In its* J. of Eng. Phys. 3 Jan. 1966 p 16-23 refs (See N66-23986 13-33) CFSTI: HC $3.00/MF $0.50

A modified formula was derived to determine thermocouple measurement errors in the surface temperature of semi-infinite solids. Considered was the case of heating and cooling from a steady temperature state in accordance with an arbitrary law. The obtained temperature-variation curve showed that if the solid was heated from a steady temperature state, the error in measurement was negative in sign; in the case of cooling, the error either exhibited a negative or a positive sign. G.G.

N66-23990 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SOLUTION OF THE THERMAL-CONDUCTIVITY PROBLEM FOR A SEMIINFINITE BODY IN THE CASE OF A VARIABLE HEAT-TRANSFER COEFFICIENT

V. M. Yudin *In its* J. of Eng. Phys. 3 Jan. 1966 p 31-37 refs (See N66-23986 13-33) CFSTI: HC $3.00/MF $0.50

The problem of a semiinfinite body in the case of a special law governing the change in the heat-transfer coefficient was analyzed. Considered was the heat propagation in a semiinfinite body where the heat-transfer coefficient diminished with time. The differential equation expressing the variable heat-transfer coefficient at the boundary was formulated and used to obtain the variable temperature of the medium by the method of Duhamel integration. A steady state solution as well as a nonsteady solution were obtained by utilizing the law of change for heat-transfer coefficient determination. G.G.

N66-24006# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON QUESTION ON EFFECTIVENESS OF COOLING OF TWO-CIRCUIT SHROUDED BLADE

A. G. Zenukov *In its* News of Inst. of Higher Learning 6 Jan. 1966 p 128-137 refs (See N66-23994 13-01) CFSTI: HC $26.30/MF $1.25

A determination is made of the cooling effectiveness of a two-circuit shrouded turbine blade. The processes of heat transfer through the shell are obtained by applying rules of a similarity theory. Consideration is given to the selection of parameters for generalization of the experimental data, and results of the experiments are detailed. Conclusions are that the blade has sufficient cooling effectiveness, and that the complication introduced by a dividing rib arrangement should be compensated by a decrease in flow rate. C.T.C.

N66-24007# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

TEMPERATURE FIELDS IN UNDERHEATED LIQUID DURING BUBBLE BOILING

L. A. Latyshev *In its* News of Inst. of Higher Learning 6 Jan. 1966 p 151–158 refs (See N66-23994 13-01) CFSTI: HC $26.30/MF $1.25

The mechanisms of the boiling of an underheated liquid were examined. It is stated that the process of heat transfer in the boundary layer due to mechanical mixing of liquid with bubbles of vapor. From this description of the mechanism of heat exchange, mathematical relationships were drawn to support this hypothesis. In addition, the influence of various parameters on the turbulent thermal conductivity in boiling boundary layers was studied. H.S.W.

N66-24010# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HEAT TRANSFER THROUGH WALL DURING PULSATIONS OF COEFFICIENTS OF HEAT EMISSION AT SURFACES OF WALL

Yu. A. Sozin *In its* News of Inst. of Higher Learning 6 Jan. 1966 p 181–191 refs (See N66-23994 13-01) CFSTI: HC $26.30/MF $1.25

The phase effect of pulsating heat emission without calculating the heat capacity of the liquid in a given system was considered. In deriving the equations, it was assumed that the temperature of the liquid in a given section of a heat exchanger remained constant, and in another instance, it was assumed that during the transition from stationary to pulsating conditions, the average value of the temperature difference remains constant in every section of the heat exchanger. From these mathematical considerations it was concluded that phase effect causes lowering of heat emission and heat transfer, therefore during pulsations, specific heat flow decreases. The influence of the heat capacity of a liquid on the magnitude of the phase effect was also considered. H.S.W.

N66-24081# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHOD OF MEASURING THE TEMPERATURE OF OBJECTS OF DIFFICULT ACCESS AT TIME OR OPERATION

S. I. Alekseyev, V. I. Kapukhin, and V. A. Nikolayenko 5 Nov. 1965 6 p Transl. into ENGLISH from Russian Patent no. 160339 (Appl. no. 809808/26-10, 24 Dec. 1962) 2 p (FTD-TT-64-970/1+2+4; AD-628300) CFSTI: HC $1.10/MF $0.50

The proposed method broadens the possibilities of the measurements of the temperature of objects, which are of difficult access at the time of operation. This is attained through the fact that at the place that is to be checked, one places a radiated diamond, and then one judges of the value for the maximum temperature by the curve of the isothermic expansion of the radiated diamond or by the point of the breakdown of the dependence of the expansion of the radiated diamond on the temperature of firing. Author (TAB)

N66-24106*# MacNeal-Schwendler Corp., San Marino, Calif.

ANALYSIS OF THERMAL TEST ERRORS RESULTING FROM IMPERFECTLY COLLIMATED SOLAR SIMULATION BEAMS Final Technical Report

Edwin J. Gooze and John J. Brooks 21 Mar. 1966 154 p refs Prepared for JPL

(Contracts NAS7-100; JPL-951330)

(NASA-CR-71776) CFSTI: HC $5.00/MF $1.00 CSCL 20M

Two effects of noncollimation of simulated solar light beams in a space simulation chamber are numerically evaluated. These include errors in incident energy flux on black flat surfaces at various angles to the mean light ray, and in incident energy flux on black flat surfaces in the region of shadows (penumbra) cast by various surfaces due to the decollimated solar simulator sources. The analytical approach used is described, and details are given on the application of the method to the general class of unshaded and shaded surfaces which are considered. Numerical results are presented in the form of energy flux density distributions within penumbras for various shaded surfaces illuminated by solar simulation models corresponding to (1) a uniformly radiating circular disc, and (2) a module source with each module being a uniformly radiating circular disc. Solutions are presented for the single knife edge, knife edge with a diffuse or a specular skirt, double knife edge, rectangular cylinder having diffuse or specular reflective properties, and circular cylinder having diffuse or specular reflective properties. M.G.J.

N66-24346# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

PROCEEDINGS OF THE FOURTH MEETING, TECHNICAL PANEL ON SOLID PROPELLANT COMBUSTION INSTABILITY

Apr. 1964 111 p refs Meeting held at Menlo Park, Calif., 1 Feb. 1964

(Contract NOw-62-0804-c)

(TG-371-7; AD-627401) CFSTI: HC $4.00/MF $0.75

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N66-24347# Ballistic Research Labs., Aberdeen Proving Ground, Md.

EXPERIMENTAL MEASUREMENTS OF ACOUSTIC EROSIVITY EFFECTS ON PROPELLANT BURNING RATES

Richard C. Strittmater, William P. Aungst, Clifton E. Thompson, and Lelland A. Watermeier *In* APL Proc. of the 4th Meeting, Tech. Panel on Solid Propellant Combustion Instability Apr. 1964 p 9–15 refs Presented at the AIAA Solid Propellant Rocket Conf., Palo Alto, Calif., Jan. 1964 (See N66-24348 13-33) CFSTI: HC $4.00/MF $0.75

Acoustic erosivity effects were experimentally measured for double base propellant, ARP, samples. A modification of the resonant tube technique developed for acoustic admittance studies was used. The test chamber, schematically illustrated, is in the form of a T-burner. Product gases were exhausted into a duct tank through a single exhaust port. The propellant was burned at both ends to attain higher acoustic amplitudes. Oscillatory pressures of 160 psi peak to peak amplitudes were obtained at a mean pressure of 300 psi. It was shown that with very high amplitude oscillations there could be the combined effect of DC erosion plus the resonant phenomena being measured. A portion of the pressure records taken at three positions in the combustion tube during the simultaneous burning of the erosion samples and drivers are shown, and are discussed. Curves plotted from data from two separate runs showing the position of the burning propellant surface as functions of both time and acoustic pressure amplitude, are given. L.S.

N66-24348# Princeton Univ., N. J.

PROBLEMS IN LIQUID PROPELLANT INSTABILITY

David T. Harrje *In* APL Proc. of the 4th Meeting, Tech. Panel on Solid Propellant Combustion Instability Apr. 1964 p 19–23 refs (See N66-24346 13-33) CFSTI: $4.00/MF $0.75 (Grant NsG-99-60)

A series of experiments using a variable-length rocket motor were conducted for determining problems of combustion instability in liquid propellant rocket engines. A pressure-sensitive time lag approach was used. By varying both length and mixture ratio, zones of first, second, and third longitudinal mode were found. Parameters studied included velocity effects, fan orientation, radial orifice alignment, chamber pressure, and interfan spacing. Mass and mixture ratio surveys across the injector face were used to indicate the overall effect of any one of the injector patterns. L.S.

N66-24349# Dartmouth Coll., Hanover, N. H. Thayer School of Engineering.

AN EXPERIMENTAL STUDY OF SOLID PROPELLANT COMBUSTION INSTABILITY IN A STANDING WAVE TUBE

A. O. Converse *In* APL Proc. of the 4th Meeting, Tech. Panel on Solid Propellant Combustion Instability Apr. 1964 p 25–29 (See N66-24346 13-33) CFSTI: HC $4.00/MF $0.75

Experiments were conducted in a standing wave steel pipe tube for developing methods of measuring the acoustic admittance of a burning propellant surface. Solid propellant samples bonded to the face of a piston were ignited by a heat nichrome wire after the piston was in motion already (the piston was driven by a variable speed electric motor through a scotch yoke). The amplitude and frequency of the pressure disturbance caused by the piston motion was under control of the investigator. Pressure was sensed by a water cooled Kistler quartz transducer located in the wall of the pipe, a few inches from the piston. The electrical signal from the transducing element was recorded with a pen writing oscillograph. Typical experimental conditions are given, and typical experimental results are both tabulated and discussed. The experiments demonstrated instability at low frequency and pressure. It is hoped that the method will yield values of the admittance. It has already indicated a nonlinear excitation mechanism. L.S.

N66-24350# Rocketdyne, Canoga Park, Calif.

BASIC PHYSICAL PROCESSES OF SOLID PROPELLANT COMBUSTION

L. W. Carlson and R. B. Lawhead *In* APL Proc. of the 4th Meeting, Tech. Panel on Solid Propellant Combustion Instability Apr. 1964 p 30–35 (See N66-24346 13-33) CFSTI: HC $4.00/MF $0.75 (Contract AF 49(638)-1208)

Interactions between high amplitude pressure waves and a burning propellant surface, for both normal incidence and grazing incidence waves, were investigated using a split tube technique. The detail of the wave splitter is schematically drawn. With this apparatus the plane shock, generated by bursting a diaphragm or detonating an explosive charge, is divided into two equal parts, one-half striking the burning propellant. The pressure transducer at the surface then measures the summation of the incident and reflected wave. The transducer which measures the other half of the wave traveling down the other side of the split tube registers the incident wave only. A small propellant slab is burned on the second side to provide essentially the same temperature gradients and gas composition as found on the other side of the tube. A surface transfer function is obtained using modified Fourier transform methods operating with the input and output traces. Typical split-tube

pressure records obtained with both unaluminized and aluminized propellants are shown. The shock tube schematic for the grazing wave studies, and pressure records for grazing incidence and normal waves for aluminized propellant are also given. L.S.

N66-24351# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y.
SHOCK WAVE-BURNING SOLID PROPELLANT INTERACTION
Vito D. Agosta *In* APL Proc. of the 4th Meeting, Tech. Panel on Solid Propellant Combustion Instability Apr. 1964 p 36–51 refs (See N66-24346 13-33) CFSTI: HC $4.00/MF $0.75

Fundamental mass and energy conservation laws and the equation of state were used for generating the gas dynamics in a theoretical analysis of the steady state and non-steady state burning rate for solid propellant shock wave interactions. A diagram of the problem showing the propellant propagating upstream in an end-burning solid propellant rocket motor is given. Governing equations are given for the shock velocity, velocity transformation, mass continuity, boundary conditions, burning rate, momentum, and state and enthalpy relations. The Rankine-Hugoniot equation, and the equation for isentropic compression are derived. The system of equations was applied to a hypothetical propellant composition, and the results showing the reflected shock characteristics for different values of burning rate exponent are tabulated. Also presented is a summary of the wave dynamics reported previously for a solid propellant study, and the coupling of the burning rate equation to the wave propagation phenomena. A schematic diagram of an end-burning solid propellant motor that was fabricated for experimentally verifying the theoretical analysis is shown. In addition to this shock wave generator, a continuous wave generator used in liquid propellant combustion studies is also schematically shown. L.S.

N66-24352# AeroChem Research Labs., Inc., Princeton, N. J.
ACOUSTIC ABSORPTION COEFFICIENTS OF THE COMBUSTION PRODUCTS OF ALUMINIZED PROPELLANTS
Arthur Ribnick and H. F. Calcote *In* APL Proc. of the 4th Meeting, Tech. Panel on Solid Propellant Combustion Instability Apr. 1964 p 52–55 refs (See N66-24346 13-33) CFSTI: HC $4.00/MF $0.75
(Contract Nonr-3477(00))

Absorption frequency measurements were made in a closed resonance tube of variable length in which small quantities of aluminized propellant were burned. The experimental data (which are plotted) were used to calculate the absorption coefficients for the combustion products, and these values agreed reasonably well with those calculated by the theory of Epstein and Carhart, indicating that the technique could be developed into a very useful tool. A schematic diagram of the resonance tube is depicted. The drive frequency is swept through the resonant frequency for different tube lengths and the output is recorded. From this, the half-power frequency difference, Δf, is determined and used to calculate the acoustic absorption coefficient. In addition, theoretical results for a non-aluminized solid propellant are graphically depicted, are compared against experimental results reported in the literature. The experimental results exceed and break away from the theory. This may be due to the formation of small particles. L.S.

N66-24354# Quantum Dynamics, Tarzana, Calif.
AN INTERPRETIVE STUDY OF UNSTABLE ROCKET COMBUSTION DATA AND A METHOD FOR THE SIMULATION OF SUCH DATA
F. F. Liu *In* APL Proc. of the 4th Meeting, Tech. Panel on Solid Propellant Combustion Instability Apr. 1964 p 58–64 refs (See N66-24346 13-33) CFSTI: HC $4.00/MF $0.75

Rocket combustion data were analyzed for understanding the transitional dynamic phenomena involved. These phenomena are due to acoustical origin, shock wave effects, chemical kinetic effects associated with phase transformations, solid-gas interactions of a mechano-elastic type, erosive burning, etc. One type of phenomenon found to be fairly persistent during the more severe cases of combustion, a typical pattern of which is depicted, is characterized by a large amplitude steep fronted major peak followed by several successive minor peaks during a repetively interrupted decaying process. This basic waveform pattern was extracted from numerous complex test data, and several notable features of this phase transitional phenomenon in its relation to pressure, temperature, and time, are discussed. In other aspects of the analysis, a plot of the Gibb energy function vs pressure is depicted, and discussed. In addition, a photograph of a recently developed device capable of simulating rocket combustion data is shown. It is a special version of a high intensity multipurpose carbon arc/xenon arc imaging device, and will be used to gain more understanding of the many basic combustion phenomena that can be obtained through electronic data treatment techniques. L.S.

N66-24357# Hercules Powder Co., Cumberland, Md. Allegany Ballistics Lab.
LOW FREQUENCY ACOUSTIC INSTABILITY STUDIES WITH DOUBLE BASE PROPELLANTS
S. F. Mathews *In* APL Proc. of the 4th Meeting, Tech. Panel on Solid Propellant Combustion Instability Apr. 1964 p 84–86 (See N66-24346 13-33) CFSTI: HC $4.00/MF $0.75
(Contract NOrd-16640)

Test firings of a non-aluminized composite modified double base propellant (DCK) in a EM-60 solid propellant rocket motor were conducted at constant frequency to determine reproducibility and the effects of equilibrium chamber pressure on the growth and decay rates of the oscillation. The signals were band pass filtered between 200 cps and 500 cps to obtain only the fundamental mode. The reduced data from these firings are presented in a table. Also shown are values for the average chamber pressure over the period where growth and decay rates were measured. The sum of the growth and decay rates were fairly reproducible, and this parameter was used to evaluate the effect of pressure on the propellant acoustic response. These data are also given, and they indicate that the propellant response at the frequency is increased at very low pressure. Based on the best data available, the experimental values yielded a response function of about 0.6 for the double base propellant at 360 cps and at an average pressure of 350 psi. L.S.

N66-24388*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYSIS OF n-HEPTANE VAPORIZATION IN UNSTABLE COMBUSTOR WITH TRAVELING TRANSVERSE OSCILLATIONS
Marcus F. Heidmann and Paul R. Wieber Washington, NASA, May 1966 30 p refs
(NASA-TN-D-3424) CFSTI: HC $2.00/MF $0.50 CSCL 21C

Vaporization histories of n-heptane drops in a combustor with superimposed traveling transverse oscillations were computed by using drop-evaporation theory. Oscillations in the rates of vaporization of an array of repetitively injected drops in the combustor were obtained from summations of individual

drop histories. A frequency response of the entire vaporization process to oscillations in pressure was evaluated. The response factor approached zero at lower frequencies and a constant negative value at higher frequencies, which indicated a potential for both the driving and damping of acoustic oscillations. Changes in combustor and drop parameters were investigated. The critical frequency increased with an increase in combustor pressure, combustor axial gas velocity, and amplitude of the pressure oscillations. It decreased with an increase in drop radius. A normalized response characteristic based on a correlation of vaporization parameters is presented. The correlation shows that the peak response occurs when a drop is vaporized in a time period approximately equal to the oscillation period. Negative gains occur when the vaporization time is greater than about three times the oscillation period. Author

N66-24436# General Electric Co., Philadelphia, Pa. Missile and Space Div.

LINE FORMATION IN A DIFFERENTIALLY MOVING NON-LTE ATMOSPHERE

John L. Kulander Mar. 1966 74 p refs Presented at the Symp. on the Interdisciplinary Aspects of Radiative Energy Transfer, Philadelphia, 24–26 Feb. 1966
(R66SD15)

The influence of an ordered macroscopic velocity directed perpendicular to the surface of a plane-parallel layer upon the line spectrum emitted by the layer is investigated. An atmosphere in which both scattering and true absorption are present is considered. In addition to the differential Doppler shift introduced into the line absorption coefficient as seen external to the atmosphere, the line source function is explicitly modified and is calculated in the presence of the velocity field. The Eddington approximation with complete redistribution of the scattered radiation over a Gaussian absorption profile is assumed. A discontinuous velocity and linear differential velocity are considered in both finite and semi-infinite layers. A two-level atomic model is assumed for the gas constituents. Solutions are obtained for simple assumed electron temperature stuctures—either constant or resembling the solar chromosphere in the statistically steady state. Author

N66-24471# Library of Congress, Washington, D. C. Aerospace Technology Div.

THE THEORY OF DETONATION, THE COMBUSTION MECHANISM, AND THE PROPERTIES OF EXPLOSIVES Surveys of Soviet Scientific and Technical Literature

Seraphim Parandjuk 21 Dec. 1965 26 p refs Compilation of abstracts
(ATD-65-116)

This compilation of abstracts is based on Soviet-Satellite open sources published in 1965. This is the fourth report in this series dealing with the theory of combustion, the combustion mechanism, and the properties of explosives. Other information included: pressure increase in the combustion front; channel effect in explosive detonation; thermal self-ignition; study-state powder combustion; low-velocity detonation in powdered explosives; additive; thermal decomposition; octogen; condensed zone burning; explosive decomposition, ethylene oxide; nitroglycerin; static electricity. There are 30 abstracts and no references. Author

N66-24586*# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.

THERMAL RESISTANCE MEASUREMENT TECHNIQUES STUDY PROGRAM Final Report

Paul H. Greer and Kenneth W. Davidson 11 Feb. 1966 197 p Prepared for JPL
(Contracts NAS7-100; JPL-K-382143)
(NASA-CR-71745) CFSTI: HC $5.00/MF $1.25 CSCL 20M

Methods of refining a thermal resistance measuring technique were examined, in order to obtain a capability of ±10% absolute accuracy and ±5% repeatability. A silicon annular epitaxial transistor was selected as the test vehicle, as it is the device to be used in a proposed accelerated program under 100°C forced draft air flow ambient conditions; a total of 355 such devices were tested. From data on correlation studies and measurements, several modifications to the thermal resistance and quality control measurement-methods were made. Further experimentation with the original test program involved studies of the thermocouple, infrared microscope, temperature-indicating paint, and water bath methods; the repeatability requirement was also verified. Data sheets are included; the results of each experimental method are assessed; and recommendations for revising various calculated values are proposed. A.O.

N66-24593*# Massachusetts Inst. of Tech., Cambridge. Engineering Projects Lab.

THERMAL CONTACT CONDUCTANCE IN A VACUUM

M. Michael Yovanovich Nov. 1965 78 p refs
(Contract NGR-22-009-065)
(NASA-CR-74619; DSR-4542-39) CFSTI: HC $3.00/MF $0.75 CSCL 20M

Equations are analytically developed for predicting the thermal contact conductance between contiguous surfaces operating in a vacuum environment. The solution is obtained by considering that any surface can be modelled as being either: nominally flat but rough, a smooth surface having cylindrical waviness, a smooth surface having spherical waviness, or a surface having either cylindrical or spherical waviness plus roughness. Since the radiative heat transfer and the conduction through the interstitial fluid are negligible, the conduction of heat across the metal contact spots is the dominant mechanism. It is considered that the prediction of thermal contact conductance must be approached by (1) examining the surface geometry, (2) proposing mathematical models for the solution of the heat transfer problem, (3) determining the surface parameters from deformation analysis, and (4) obtaining experimental data to substantiate the proposed models. C.T.C.

N66-24595*# Illinois Univ., Urbana. Engineering Experiment Station.

SOME INFLUENCES OF MACROSCOPIC CONSTRICTIONS ON THE THERMAL CONTACT RESISTANCE

A. M. Clausing Apr. 1965 53 p refs
(Grant NsG-242-62)
(NASA-CR-74622; MF-TN-242-2) CFSTI: HC $3.00/MF $0.50 CSCL 20M

Accomplishments are reported in a theoretical and experimental study of some influences of macroscopic constrictions on thermal contact resistance in a vacuum environment. A numerical solution is given for the constriction resistance which removes the error present in an approximate analytical solution previously employed. In addition, the solution is valid for thin regions. The model is applied to the analysis of contacts between dissimilar metals, and it was found that the model is capable of qualitatively predicting the resulting directional effect. C.T.C.

N66-24603*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

STUDY OF THERMAL ISOLATION TECHNIQUES Final Engineering Report

1 Mar. 1966 220 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950950)
(NASA-CR-71743; M-92-66-1) CFSTI: HC $6.00/MF $1.25
CSCL 20M

The development of thermal isolation techniques, feasible for protecting temperature sensitive materials and components in typical spacecraft during a terminal heat sterilization cycle is described. Data were compiled on the proposed sterilization environment, typical spacecraft components, and sterilization procedures and requirements. In addition, a feasibility study was made of various isolation methods. Major design problems were delineated along with proposed solutions, and a design plan for isolation systems was outlined. A prototype lander configuration is described, and a limited parametric study of weight, volume, power requirements, and thermal isolation device packaging recommendations are presented. It is concluded that thermal isolation of temperature sensitive components during dry heat terminal sterilization is feasible from a thermodynamic viewpoint, and can best be accomplished by circulating a liquid coolant through or around the component. The effects of efficacious thermal isolation systems on post-launch temperature control can be made negligible by proper thermal and mechanical design. A.O.

N66-24671# Lockheed Missiles and Space Co., Sunnyvale, Calif.

RADIANT HEAT EXCHANGE IN THE NEIGHBORHOOD OF THE STAGNATION POINT OF A BLUNT BODY

Z. S. Galanova [1966] 14 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., no. 1, 1966 p 120–130

The influence of radiant heat transfer on convective heat transfer is considered, and radiant heat flux at a specific point from some gas volume is computed in connection with a study dealing with the radiant heat exchange near the stagnation point of a plane or axisymmetric body around which a hypersonic stream flows. The Navier-Stokes and a radiation transport equation are used to describe the flow of a radiating gas between the shock wave and the body; and the problem is reduced to one amenable to machine programming. An expression is given for the radiant heat flux at the stagnation point from a spherical segment with known distribution parameters, and a comparison is made with flux from a flat layer. Equations are given to permit an estimate of the assumption of a plane-parallel layer and a more accurate determination of the radiant heat flux. M.W.R.

N66-24685# General Electric Co., Philadelphia, Pa. Missile and Space Div.

SPACECRAFT COATINGS, BEHAVIOR IN THE SPACE ENVIRONMENT

T. Neville, J. Hackworth, and C. Boebel Aug. 1964 20 p Presented at the 5th Ann. Struct. and Mater. Conf. of the Am. Inst. of Aeron. and Astronautics, Apr. 1964
(Doc-64SD264)

As spacecraft are designed for longer operational life and as their functions and construction become more complex and sophisticated, the effects of the space environment on materials assumes increasing importance. The increased utilization of organic materials has posed many potential problems, not only the degradation in properties of the materials themselves, but also the effects of the condensation of sublimation products upon cooler optical surfaces. This report presents the results of a laboratory program to evaluate the effects of space radiation upon thermal control surfaces and the effects of condensation of out-gassing products upon optics. Environmental facilities included vacuum chambers equipped with cryogenic walls, thermal plates and a mass spectrometer for identification of out-gassing materials. Data are presented which show the changes in the solar absorptance and total emittance of thermal control materials resulting from space radiation. Transmittance changes in the visible and infrared regions of the spectrum together with lens resolution losses, are used to show effects of condensed organic out-gassing molecules upon spacecraft optics. This program demonstrates that space simulation in the laboratory is a useful tool for materials engineers. Even with inherent limitations, it provides invaluable data on the performance of spacecraft materials. Author

N66-24697*# General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.

POTASSIUM CORROSION TEST LOOP DEVELOPMENT Quarterly Progress Report No. 9, 15 Jul.–15 Oct. 1965

E. E. Hoffman, ed. [1965] 48 p refs
(Contract NAS3-2547)
(NASA-CR-54912) CFSTI: HC $2.00/MF $0.50 CSCL 20M

The boiling and condensing operation of the prototype corrosion test loop reached test conditions and the loop was run for 1785 hours of stable operation. The running operation procedures are outlined, and the temperature and pressure data are presented in graph form. The stability in the potassium circuit was attributed mainly to the pressure drop across the metering valve at the preheater inlet and to the wire wound plug section located in the first 12 inches of the boiler. Argon and nitrogen/carbon monoxide were the principal gasses in the chamber, and at the end of the test period were responsible for approximately 83% of the pressure. Argon instabilities in the getter-ion pump were reported. The test chamber environmental monitoring, boiler performance, and calibration of sodium and potassium flowmeters are discussed. Analysis of loop performance indicated that the variations between actual test and design test conditions were minor. No trends toward component degradation were detected. N.E.N.

N66-24705# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE APPROXIMATE MODELING OF COMBUSTION CHAMBERS OF GAS TURBINES ON NATURAL GAS

A. A. Shatil and V. D. Murashko 18 Feb. 1966 20 p refs Transl. into ENGLISH from Teploenerg. (USSR), no. 7, 1965 p 54–58
(FTD-TT-65-1777/1+2+4; TT-66-60734; AD-629474)
CFSTI: HC $1.60/MF $0.50

The combustion process in gas turbine chambers is reviewed, and an approach based on a diffusion–kinetic analysis is presented. The conditions of modeling which are applicable to gas combustion chambers are listed. Equations are developed representing the diffusion and kinetic processes, and the value of the completeness of combustion is found. N.E.N.

N66-24710# New Hampshire Univ., Durham. Dept. of Mechanical Engineering.

EFFECT OF GEOMETRY ON LOCAL CONVECTIVE COEFFICIENTS FOR AN UNBAFFLED CIRCULAR FIN ASSEMBLY

Jack Leslie Baker (M.S. Thesis) Jun. 1965 61 p refs
(Contract AF 33(608)-1256)
(AD-624646) CFSTI: HC $3.00/MF $0.75

The geometry of a fin assembly effects the distribution of h on a fin. Decreasing the fin spacing increases h circumferentially on the front edge of the fin but decreases h at the

fin root. The h values decrease with an increase of fin diameter. The h values, in general, decrease from the front to the rear of the fin. The use of temperature differences in the nodal equations is more accurate than the subtraction of actual temperatures. TAB

N66-24720# Thiokol Chemical Corp., Denville, N. J. Reaction Motors Div.

AFOSR COMBINED CONTRACTORS MEETING ON COMBUSTION DYNAMICS RESEARCH Compilation of Abstracts

[1965] 77 p Meeting Held 1–4 Jun. 1965

(Contract AF 49(638)-1505)

(AFOSR-65-0590; AD-623186) CFSTI: HC $3.00/MF $0.75

A series of abstracts are presented on the combustion dynamics of liquid and solid propellant rocket engines. Topics include combustion instability mechanisms and studies of combustion instability under various conditions for liquid and gaseous propellant engines; supersonic combustion problems, waves and oscillations; injector design; jet mixing; thermal and light emission; and propulsion chemistry. Solid propellant research includes ignition and burning, combustion characteristics and combustion instability, and burning rate measurements. E.A.O.

N66-24726# Minnesota Univ., Minneapolis.

GALERKIN'S METHOD AND THE LOCAL POTENTIAL

B. A. Finlayson and L. E. Scriven [1965] 9 p refs Presented at the Symp. on Non-Equilibrium Thermodyn., Variational Tech. and Stability, Chicago, 19 May 1965 Submitted for Publication

(Grant AF-AFOSR-219-63)

(AFOSR-66-0286; AD-628582) CFSTI: HC $1.10/MF $0.50

The advantages of viewing the local potential method as an application of Galerkin's method are threefold: (1) variational formalism is avoided by using Galerkin's method, a conceptually simple, straightforward approximating scheme; (2) convergence proofs and other useful mathematical information are sometimes available for Galerkin's method; and (3) inasmuch as Galerkin's method is actually only one member of a family of weighted-residual methods for direct approximation using trial functions with adjustable parameters, the way is plain to alernative direct methods for attacking a problem. From the standpoint of fluid mechanics and transport theory there is considerable need for careful and systematic comparisons of these more-or-less well-established schemes and for increased attention to them by mathematicians or numercial analysts. TAB

N66-24762# Library of Congress, Washington, D. C. Aerospace Technology Div.

COMBUSTION INSTABILITY IN LIQUID AND SOLID PROPELLANT ROCKETS Surveys of Soviet Scientific and Technical Literature

Paul Vantoch 22 Nov. 1965 60 p refs Compilation of abstracts

(ATD-65-106)

This comprehensive report is based on Soviet open sources published 1960–1965 (with a few sources from earlier dates); it is the first in a series dealing with combustion instability in liquid- and solid-propellant rockets. Several theoretically derived criteria for combustion instability are discussed and their limitations for predicting performance characteristics are pointed out. The effect of various factors such as pressure, temperature gradient, temperature sensitivity, and particle size on the burning velocity are reviewed and their significance for instability is outlined. Other potential elements of combustion instability such as the phase transformations and physical-reaction mechanisms are also treated. Articles on high- and low-frequency instability, theoretical derivation of stability criteria, and experimental investigations of instability are reviewed. Factors influencing instability are summarized and discussed together with suggested measures for suppressing instability. Author

N66-24776# RAND Corp., Santa Monica, Calif.

INITIAL VALUE METHODS FOR THE BASIC BOUNDARY VALUE PROBLEM AND INTEGRAL EQUATION OF RADIATIVE TRANSFER

H. H. Kagiwada and R. E. Kalaba Feb. 1966 19 p refs

(Contract AF 49(638)-1700; Proj. Rand)

(RM-4928-PR; AD-629132) CFSTI: HC $1.60/MF $0.50

The report presents a new approach to the study of integral equations and linear unstable two-point boundary value problems. The memorandum considers the problem of radiative transfer in a plane-parallel atmosphere which absorbs radiation and scatters it isotropically, there being a continuous distribution of primary internal sources of radiation. An effective numerical technique for calculating the internal intensity and the source functions is sought. A major consideration is the computer's ability to solve initial-value problems for large systems of ordinary differential equations. The authors derive new differential-integral equations for the internal intensity at a fixed point and direction, and the source function at a fixed point, the new independent variable being the thickness of the atmosphere. Using standard quadrature techniques, they approximate these equations by systems of ordinary differential equations whose numerical treatment is straightforward. Author (TAB)

N66-24875# Chalmers Univ. of Technology, Goteborg (Sweden). Inst. of Chemical Engineering.

SIMULTANEOUS MASS AND HEAT TRANSFER IN THE SYSTEM: PURE LIQUID–INERT GAS

Åke Jernqvist 1965 79 p refs *Its* Trans., no. 297

(Rept.-1) CFSTI: HC $3.00/MF $0.75

This paper attempts to systematize in a brief way the various concepts related to the adiabatic change of state of a pure liquid–inert gas system using the two film theory as a model. Molal units are used throughout the paper which simplifies most of the equations. Part I discusses the influence of large driving forces on the mass and heat transfer coefficients. Part II introduces new definitions of the adiabatic final temperature, the adiabatic saturation temperature, and the adiabatic equilibrium temperature. Part III presents the graphic treatment of the adiabatic change of state. The concepts used are tabulated in summary form. Emphasis is placed on systems in which complete analogy between heat and mass transfer prevails. R.N.A.

N66-24924*# National Aeronautics and Space Administration, Washington, D. C.

THE LAMINAR BOUNDARY LAYER IN A RADIATING-ABSORBING GAS NEAR A FLAT PLATE [LAMINARNYY POGRANICHNYY SLOY V IZLUCHAYUSHCHE-POGLOSHCHAYUSHCHEM GAZE OKOLO PLOSKOY PLASTINKI]

V. P. Zamurayev May 1966 18 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Tech. Fiz. (Moscow), no. 3, 1964 p 73–80

(NASA-TT-F-10177) CFSTI: HC $1.00/MF $0.50 CSCL 20M

The hypothesis of local thermodynamic equilibrium, according to which the radiating power and absorption coefficient are related by Kirchhoff's law, is applied to the steady state problem of laminar flow of a radiating-absorbing gas. The medium is assumed to be gray. The radiation flux along the plate is neglected in comparison with the radiation flux across

the plate. It is pointed out that such an assumption is valid provided the temperature variation along the plate over the length of the radiation path is small. The effect of but slight temperature variation is to render the radiation flux across the plate determinable by the temperature profile in the given section. The wall is assumed to be absolutely black, and the physical properties of the medium may be temperature dependent. The asymptotic behavior of the heat transfer far away from the tip of the plate is considered. A difference method of solving a system of partial differentials with a complex integral–differential energy equation is used to solve the problem over the entire length of the plate. D.T.

N66-24930*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

INITIAL INVESTIGATION OF A METHOD WHEREBY A CRYOGENIC PROPELLANT LIQUID IS INSULATED FROM HEAT LEAK BY THE PROPELLANT AND ITS SACRIFICIAL BOILOFF

William A. Olsen Washington, NASA, May 1966 39 p refs (NASA-TN-D-3228) CFSTI: HC $2.00/MF $0.50 CSCL 20M

A small-scale experiment is reported which demonstrated that a few closely spaced thin-film plastic "bags," hydraulically connected and mounted close to the propellant tank wall with liquid hydrogen in all volumes, could act as sufficient insulation to cause liquid in the volume nearest the tank wall to boil off sacrificially much of the incoming heat leak. Thus, much of this heat leak is prevented from reaching the liquid shielded by this insulator. As a consequence, the temperature of the liquid in a pressurized tank increases at a much slower rate than it would if there were no bags. In this case, the heat leak to the shielded liquid is essentially independent of the incoming heat leak to the tank and depends only on the tank pressure. The lowest heating rates are possible for low tank pressures. This method could result in a weight saving for booster rocket vehicles designed for its application because it can reduce the pump cavitation problem by decreasing the liquid heating rate. Further weight saving appears to be possible in pressurization system weight. The greatest overall weight saving occurs at low tank pressures. Author

N66-24936*# National Bureau of Standards, Washington, D. C.

THE NEW TUNGSTEN-FILAMENT LAMP STANDARDS OF TOTAL IRRADIANCE

Ralph Stair, William E. Schneider, and William B. Fussell 8 Apr. 1966 22 p refs
(NASA Order R-116)
(NASA-CR-74715; NBS-9084) CFSTI: HC $1.00/MF $0.50 CSCL 20M

The instrumentation and methods used in establishing lamp standards of total irradiance are described. These tungsten-filament lamps are of three sizes (100, 500, and 1000 watt), operate at color temperatures between 2700° and 2850° K, and are based upon the spectral radiance of a blackbody. The standards were set up on dc operation, and all current and voltage measurements are made with potentiometric equipment. The operational modes are discussed, and tabulated data on total irradiance are given for the three lamp sizes when operated at 0.75, 3.60, and 7.70 amperes. The factors involved in estimating the accuracy of the assigned values are listed, and it is concluded that an overall certainty of the order of ±1.0% should be attained, based upon a value of 1.4380 cm deg K for c_2. It is also estimated that proper care and handling should insure a life expectancy of 50 hours with change in total irradiance not exceeding about 1 percent. M.G.J.

N66-24938*# Space Technology Labs., Inc., Redondo Beach, Calif.

AN INVESTIGATION OF THE THERMAL RADIATION PROPERTIES OF CERTAIN SPACECRAFT MATERIALS Final Report

J. T. Bevans, G. L. Brown, E. E. Luedke, W. D. Miller, K. E. Nelson et al 31 Dec. 1962 104 p refs
(Contract NAS5-1102)
(NASA-CR-74772; STL-8633-6014-SU-000) CFSTI: HC $4.00/MF $0.75 CSCL 20M

Studies were conducted to determine the thermal radiation property versus thickness characteristics of the sulfuric anodizing process for several alloys, and other aluminum anodizing processes were examined to find alternative methods of securing properties comparable to the sulfuric acid method. The measurement instrumentation is described, the specific sulfuric acid processes used are summarized, and the nonsulfuric anodizing electrolytes tested are listed. Anodizing processes were also investigated to determine what values of solar absorptance and emittance could be obtained by various anodizing techniques. Results indicated that the degradation effects of the ultraviolet and vacuum environment are particularly severe for sulfuric anodized aluminum. Techniques developed for ultraviolet and vacuum degradation testing are described, and preliminary findings show that accelerated testing is not valid, as equal exposures, but different irradiation levels do not yield equal degradation. Although it is concluded that anodized aluminum is a promising material for spacecraft thermal control, the need for establishing the variables involved in processing and in degradation is stressed. M.G.J.

N66-24993*# National Bureau of Standards, Washington, D. C.

SURVEY OF THERMODYNAMIC PROPERTIES OF THE COMPOUNDS OF THE ELEMENTS CHNOPS Seventh Preliminary Report, 1 Jan.–31 Mar. 1966

George T. Furukawa, Mary K. Buresh, Martin L. Reilly, George T. Armstrong, and Gerald D. Mitchell 1 Apr. 1966 74 p refs
(NASA Order R-138)
(NASA-CR-74719; NBS-9089) CFSTI: HC $3.00/MF $0.75 CSCL 20M

The analysis of the heat capacity data of L-serine, L-methionine, furan, and urea is complete and tables of calculated thermodynamic properties are presented. The sources of data used to obtain the thermodynamic properties are described. The structural formula, molecular weight, and temperature range of each compound are given in the text. Also included are tables of thermodynamic functions for inorganic and organic CHNOPS compounds containing one carbon atom per molecule. R.N.A.

N66-25125# Aktiebolaget Atomenergi, Stockholm (Sweden).

HEAT TRANSFER ANALOGIES

Ajay Bhattacharyya Nov. 1965 66 p refs
(AE-201)

Descriptions of various analogs used to study different steady-state and unsteady-state heat transfer problems are given. The analogs covered are: hydraulic; membrane; geometric electrical; and network. A comparison of the different analogs is presented in the form of a table. 81 references are cited. Author (NSA)

N66-25150# Joint Publications Research Service, Washington, D. C.

EVALUATION OF THE EFFECTIVENESS OF THE EXPLOSION OF CHARGES WITH AIR SPACES

F. A. Baum 28 Feb. 1966 11 p refs Transl. into ENGLISH from Nauchno-Tekhn. Gornoye Obshchestvo Vzyvnoye Delo (Moscow), v. 54, no. 11, 1964 p 48–52
(JPRS-34322; TT-66-30763) CFSTI: HC $1.00

A theoretical analysis was conducted of the physical processes involved in the use of drilled charges with air spaces for the explosive deformation of rocks. The size of the charge and the dimensions of its individual parts, and the relationship between these dimensions and the dimensions of the air spaces were identified as the parameters which must be considered when conducting operations using an explosive device of this type. It is stated that a gas cavity is formed which is greater in volume than the cavity formed when a solid charge is used and the volume of rock destroyed is proportional to the volume of the gas chamber. The hypothesis that the initial stage of the deformation of rock is determined by the magnitude of the impulse transmitted during the explosion is considered, and mathematical relationships which support this concept are developed. It is concluded that charges of this design provide a more uniform fragmentation of the rock, and make it possible to reduce the size of the stemming without reducing the efficiency. H.S.W.

N66-25163*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
USE OF THE CURTIS–GODSON APPROXIMATION IN CALCULATIONS OF RADIANT HEATING BY INHOMOGENEOUS HOT GASES
B. Krakow, H. J. Babrov, G. J. Maclay, and A. L. Shabott (Warner and Swasey Co., Flushing, N. Y.) 15 Mar. 1966 32 p refs Prepared by Warner and Swasey Co.
(Contract NAS8-11315)
(NASA-TM-X-53411) CFSTI: HC $2.00/MF $0.50 CSCL 20M

The accuracy of the Curtis–Godson approximation has been tested experimentally. Infrared spectral transmittances of inhomogeneous hot samples of H_2O and CO_2 were measured. Each inhomogeneous hot gas specimen consisted of two or three homogeneous zones in series. The transmittance of each zone was measured, as was the transmittance of the entire multi-zone assembly. The measured transmittance of each inhomogeneous path was compared with a transmittance calculated from the homogeneous zonal transmittances, using the Curtis–Godson approximation in conjunction with a random band model. The measured and calculated inhomogeneous transmittances agreed within about .01 to .02. The error appeared to be due more to the band model theory than to the Curtis–Godson approximation. Author

N66-25174# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Porz (West Germany).
MEASUREMENTS OF RELAXATION EFFECTS IN NOZZLE FLOW OF HOT COMBUSTION GASES BY MEANS OF A SHOCK TUBE TECHNIQUE [MESSUNGEN VON RELAXATIONSEFFEKTEN IN DUSENSTROMUNGEN HE ISSER VERBRENNUNGSGASE MITTELS EINER STOSSROHRANORDNUNG]
Thomas Just and Horst Pippert Jan. 1966 43 p refs In GERMAN; ENGLISH summary
(DLR-FB-66-01) CFSTI: HC $2.00/MF $0.50

Chemical relaxation effects in nozzle flow were investigated by measuring the temperatures along the nozzle. The high temperatures required were easily produced by detonation waves. Temperatures were measured with the aid of the atomic-line-reversal method. This method had to be modified on account of the short time intervals of constant flow in our shock tube. Hydrocarbons were burnt with air, respectively oxygen. First results for varied angles of the nozzles are reported. Author

N66-25177# Lockheed Missiles and Space Co., Sunnyvale, Calif.
REMARKS ON THE PRESENT STATUS OF SPACECRAFT THERMAL CONTROL SURFACE DEVELOPMENT
L. A. Mc Kellar 28 May 1965 36 p refs
(LMSC-M-35-62-2)

This paper is in response to "The Role of Organic and Inorganic Coatings as Thermal Control Coatings in Space," by H. H. Hormann, and represents an expansion on certain points contained in Mr. Hormann's paper. The present status of solar reflector, solar absorber, and flat reflector thermal control surfaces is reviewed. Existing practical application and repair problems are pointed out. Property measurement procedures are reviewed, including the development of inspection devices and *in situ* measurement techniques for environmental tests. Environmental stability data are reviewed, including data on exposures in vacuum to neutron-plus gamma radiation, 0.8 MeV electrons, 5 keV electrons, 130 keV protons, and combined exposures with ultraviolet radiation. Synergistic damage is noted. The need for further data at high and low temperatures is pointed out. A program studying the basic mechanism of ultraviolet-induced optical damage to zinc oxide is reviewed. Author

N66-25246 Aerojet-General Corp., Sacramento, Calif.
COOLDOWN OF LARGE-DIAMETER LIQUID HYDROGEN AND LIQUID OXYGEN LINES
J. C. Commander and M. H. Schwartz 20 Apr. 1966 60 p refs
(Contract NAS3-2555)
(NASA-CR-54809; AGC-8800-54) CFSTI: HC $3.00/MF $0.50 CSCL 20M

This report describes the chilldown of large cryogenic systems located in test zone E of the M-1 engine test complex. Theoretical analyses as well as actual experience are included. Author

N66-25248*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ENERGY TRANSPORT BY THERMAL FIELD EMISSION
James F. Morris Washington, NASA May 1966 20 p refs
(NASA-TN-D-3448) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Theoretic evaluations of heat transfer caused by electron emission opposed by a barrier that terminates at the Fermi level on the emitter surface are presented. For these predictions, electric fields vary from 10^6 to 10^8 volts per centimeter, work functions range from 1 to 8 volts, and emitter temperatures span from 0° to 3000°K. Current density and cooling voltage show graphically the trends of emitter cooling (cooling rate equals current density times cooling voltage); in addition, values of cooling rate, current density, and cooling voltage appear in tables. Because true transport rates for thermal field emission probably exceed these estimates (up to 10^9 W/cm^2), high fields provide powerful processes for heating and cooling. Author

N66-25262# Cornell Univ., Ithaca, N. Y. Materials Science Center.
THE NORMAL SPECTRAL EMISSIVITY OF ISOTROPIC AND ANISOTROPIC MATERIALS
Gordon Wilbert Autio (M.S. Thesis) Feb. 1966 142 p refs
(Rept.-394)

The normal spectral emissivity of both isotropic and anisotropic materials was measured in order to examine the effects of crystallographic orientation, at or near the surface, upon the emission of radiant energy. A new technique is employed in measuring the emissivity which involves a direct energy method of comparing the spectral radiant energy emitted by the real body to that of a well defined black body cavity under equivalent conditions. Experimental data is obtained for wavelengths in the near infrared (1.5 to 13 microns) at temperatures between 800°C and 1200°C in a hydrogen atmosphere. Standard metallographic and X-ray techniques are employed to describe surfaces and orientations before and after the experiments. Isotropic single crystal nickel and highly anisotropic pyrolytic graphite are the prime materials investigated, and possible comparisons are made with previously published results. C.T.C.

N66-25305# Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.

SOLAR INCIDENCE FACTORS FOR THERMAL ANALYSIS OF IMPERFECTLY COLLIMATED RADIATION IN SOLAR SIMULATORS

R. P. Bobco and C. P. Stensgaard, Jr. May 1966 35 p refs *Its* Rept.-7
(SSD-60165R)

The computation of solar incidence factors for use in estimating the effects of imperfectly collimated solar simulator beams is shown to be related to all algorithms for obtaining conventional shape factors used in diffuse radiant exchange. Superposition techniques are used at three analytical levels to reduce to simpler problems the complex problem of finding solar simulator incidence factors. First, superposition is used to find the energy incident at any location in a test zone which is irradiated by directional, variable intensity beams from several discrete source regions. Second, it is shown how complex source intensity distributions may be decomposed into a sum of analytically tractable functions. Third, conventional shape factors, which may be introduced as elements of the solar incidence factor, are expressed in terms of components in three mutually orthogonal directions. With these techniques, it is possible to estimate the irradiation on inclined surfaces and in penumbral regions without recourse to sophisticated analysis. Numerical results are presented for an array of hexagonal source zones in a collimator type of solar simulator. Author

N66-25307*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

PROGRAM PLAN FOR EARTH-ORBITAL LOW g HEAT TRANSFER AND FLUID MECHANICS EXPERIMENTS

M. E. Nein and C. D. Arnett 10 Feb. 1966 163 p refs
(NASA-TM-X-53395) CFSTI: HC $5.00/MF $1.00 CSCL 20M

A feasibility study for orbital experiments in fluid mechanics and heat transfer is presented. The need for fluid mechanic and heat transfer experiments under low gravity and space vacuum conditions is analyzed. The limitations of earth based experiments are discussed and approaches for the design of an orbital experiment module are given. It is shown that orbital experiments in cryogenic fluid mechanics and heat transfer can be conducted with scale models of future systems. The concepts advanced in this paper can serve as a basis for detailed design of a flight system and the timely accomplishment of integrating these experiments into the earth orbital Apollo missions. Author

N66-25365# Argonne National Lab., Ill.

AN INVESTIGATION OF INSTABILITIES ENCOUNTERED DURING HEAT TRANSFER TO A SUPERCRITICAL FLUID

Archie Junior Cornelius Apr. 1965 103 p refs
(Contract W-31-109-ENG-38)
(ANL-7032) CFSTI: HC $3.00/MF $0.75

The unstable behavior of heat transfer in loops operating at supercritical pressures is investigated. The mechanisms that trigger and maintain the observed pressure and flow oscillations are postulated. NSA

N66-25375*# General Electric Co., Philadelphia, Pa.

TRANSIENT DETERMINATION OF THE THERMAL CONDUCTIVITY OF A LOW DENSITY PHENOLIC NYLON CHAR Final Report

23 Jul. 1965 39 p refs
(Contract NAS1-2979-1)
(NASA-CR-66099) CFSTI: HC $2.00/MF $0.50 CSCL 20M

Four transient thermal conductivity determinations have been made on a low density phenolic nylon char. The transient technique has yielded significantly lower thermal conductivity values than those obtained by steady state means. This is attributed in part to the non-heat-treated nature of the char and its continuing pyrolysis during severe transient heating. The inconsistency of attributing thermophysical parameters based on steady state measurements to the operational performance of ablative heat shield systems is pointed out. Author

N66-25376*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

A CALCULATION METHOD FOR THE ABLATION OF GLASS-TIPPED BLUNT BODIES

John D. Warmbrod 12 Apr. 1966 91 p refs
(NASA-TM-X-53527) CFSTI: HC $3.00/MF $0.75 CSCL 20M

A calculation method is presented to compute the trajectory and ablation characteristics at the stagnation point of a glass sphere entering into the atmosphere of the earth from an arbitrary point in space. The underlying equations employed by the method include the transient effects, internal radiation, melting and nonequilibrium vaporization of the glass–liquid layer. A computer program written in Fortran IV language and a detailed description of the preparation of input for this program are included. The program is particularly applicable to the study of tektites and their atmospheric entry. The method and program could easily be altered to calculate the ablation at the stagnation point of a spherical glass tip on a missile-shaped body. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N66-23896# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

DOD PROGRAMMING SYSTEM. AN EXPLANATION AND EVALUATION

Stewart De Witt Hawkins, Paul Richard Miller, and Paul Archibald Cameron, Jr. (M.S. Thesis) Aug. 1965 164 p refs
(GSM/SM/65-5; AD-628101) CFSTI: HC $16.00/MF $1.00

The DoD Programming System was introduced in 1961-62 by Secretary McNamara to integrate the planning-programming-budgeting phases of defense decision making. This report is an explanation of how the system operates and an

evaluation of it, using as a standard basic management principles. This system provides for planning and programming to be conducted on a mission oriented basis and for the overall review of the services programs. It is a more effective method of defense management than was previously used. Current problems with the DoD Programming System however have caused OSD to be pre-occupied with detailed management of short- and mid-range goals to the detriment of long-range planning and general policy guidance. Author (TAB)

N66-24117*# George Washington Univ., Washington, D. C.
CONTRACTOR DECISION MAKING AND INCENTIVE FEE CONTRACTS
Charles E. Bradley and Clayton Mc Cuistion 22 Dec. 1965 65 p refs
(Grant NsG-425)
(NASA-CR-74217) CFSTI: HC $3.00/MF $0.50 CSCL 05A

The incentive contract form is examined in terms of elementary decision theory, incorporating the contractor's utility function and the question of choice under uncertainty. This approach was taken to clarify the contractor's decision problem and to develop the necessary insight as to the value of this contract for stimulating contractor efficiency. Fundamental inconsistencies in incentive contracting are assessed, with emphasis placed on contractor risks and contract negotiations under conditions of uncertainty. A general model of contractor behavior is developed as a formal description of the approach to contract negotiations; it describes how the contractor can improve his situation with an incentive contract—not through cost efficiency efforts but through negotiations. The fee function is also examined, and several examples of contractor motivation are given. It is pointed out that experience with incentive contracts clearly indicates that cost sharing by the contractor is not sufficient to stimulate efficiency, and that there is a general absence of a potential for negotiating fee arrangements which will stimulate such efficiency. M.G.J.

N66-24201# Massachusetts Inst. of Tech., Cambridge.
SURVEY OF TECHNOLOGY FOR HIGH SPEED GROUND TRANSPORT, PART I
15 Jun. 1965 523 p refs
(Contract C-85-65)
(PB-168648)

High Speed Ground Transport (HSGT) systems are surveyed in connection with the Northeast Corridor Transportation Project to determine facilities for both passengers and freight between the region extending roughly from Boston, Massachusetts, and Washington, D. C., which will be required in the 1980's and thereafter. System requirements and concepts are discussed, and probable HSGT system parameters are proposed. A detailed analysis is made of technology in the many areas which require further research and development, such as vehicle support and suspension systems, propulsion systems, tunnels, control systems, and scheduling and system operation. Appendices cover details of a visit to Japan, highway development, and urban and organizational problems connected with the HSGT development. M.W.R.

N66-24205# Congress. House. Committee on Science and Astronautics. Subcommittee on Space Science and Applications.
1967 NASA AUTHORIZATION, NO. 4, PART 3
Washington, GPO, 1966 921 p Hearings Before the Subcomm. on Space Sci. and Appl. of the Comm. on Sci and Astonautics, 89th Congr., 2d Sess. on H.R. 12718 (Superseded by H.R. 14324), 17, 21-24, 28 Feb.; 1-4 Mar. 1966
GPO: $2.75

The hearings on NASA's fiscal year 1967 budget request in the area of space science and applications are reported, and a detailed presentation is given of past achievements, scientific and technological objectives, and ultimate goals for space exploration. Each program is discussed in relation to the requested appropriation, and explanatory data are presented on the planned expenditures for each phase. Statements are also included on the biosatellite program; physical, behavioral and environmental biology; exobiology; planetary quarantine; the automated biologcial laboratory; experiment definitions for Apollo applications; space science experiments on Gemini and Apollo missions; manned space science; Apollo lunar surface science; Gemini and Apollo earth-orbital science; man's role in space research; and lunar and planetary programs. The application of space-generated technological developments to the economy is also discussed, and details are given on the purpose and scope of the sustaining university program. M.G.J.

N66-24312# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME 2, NO. 2
Feb. 1966 67 p refs Sponsored by DOD

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1. PLASMA DIAGNOSTICS BY MICROWAVES S. G. Hibben p 1-7 refs (See N66-24313 13-25)
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11. PETR PETROVICH BUDNIKOV p 47-49 refs

BOOK REVIEWS

N66-24481# Congress. Senate. Committee on Aeronautical and Space Sciences.
NATIONAL COMMUNICATIONS SATELLITE PROGRAMS
Washington, GPO, 1966 124 p Hearings before Comm. on Aeron. and Space Sci., 89th Congr., 2d Sess., 25-26 Jan. 1966 GPO: $0.35

Presented are the minutes of hearings on the national communications satellite program before the Senate Committee on Aeronautical and Space Sciences in January, 1966.

Investigated were Department of Defense and NASA activities in connection with the satellite communication system, and its future developments. G.G.

N66-24483*# Congress. Senate. Committee on Aeronautical and Space Sciences.
NASA AUTHORIZATION FOR FISCAL YEAR 1967
Washington, GPO, 1966 768 p Hearings Before Comm. on Aeron. and Space Sci., 89th Congr., 2d Sess., 28 Feb., 1–4 Mar. 1966 GPO: HC $2.25; CFSTI: MF $3.50

The Senate Committee on Aeronautical and Space Sciences hearings in February and March, 1966 on appropriations authorization are presented. Funding pertains to research and development, construction of facilities and administrative operations, and related purposes. Summary statements highlighting current NASA program status, significant developments, problem areas, changes, and budgetary considerations are included. G.G.

N66-24628# Joint Publications Research Service, Washington, D. C.
THE CRITERIA OF OPTIMAL CONTROL OF A COMPLEX PRODUCTION SYSTEM AND OF ITS INDIVIDUAL COMPONENTS
V. M. Dobkin *In its* Autom. Operational Management of Processes of Production 8 Apr. 1966 p 214–226 refs (See N66-24515 13-10) CFSTI: $7.00

The factors characterizing the quality of production control are reviewed, in relation to establishing criteria of optimality. Factors determining the selection of the optimum conditions of production are defined as: (1) the relative economic nature of a given production facility in comparison with that of other production facilities turning out the same product; and (2) the deficit status of production, or the relation between the requirement of the national economy for a given product and the productivity of the effective capacities. The influence of these factors is evaluated, and the conditions of optimum control of a group of parallel components are analyzed. Control algorithms are developed, and a system of two consecutive processes is presented for optimizing the group of consecutive components. M.G.J.

N66-24652# Congress. House. Committee on Science and Astronautics
NASA AUTHORIZATION FOR 1967, PART 1, NO. 4
Washington, GPO, 1966 381 p Hearings Before Comm. on Sci. and Astronautics, 89th Congr., 2d Sess. on H.R. 12718 (Superseded by H.R. 14324), 10, 11, and 22 Mar. 1966

The broad context of the total NASA program, its accomplishments, its present status, and the implications for the future are discussed in relation to the presidential recommendations for authorization of funds. Management policies, planned activities, and schedules for accomplishing specific objectives are detailed for the Offices of Advanced Research and Technology, Tracking and Data Acquisition, Manned Space Flight, and Space Science and Applications. Research and development requirements are identified, and the operational capabilities and contributions of each NASA center are discussed. Funding requirements for the various programs are explained. Minor construction involving new and existing structures, and alteration projects funded from the administrative operations appropriation are listed. An analysis of data processing equipment in use at the NASA installations is also included. M.G.J.

N66-24835# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME 2, NUMBER 4
Apr. 1966 90 p refs

This volume contains several scientific studies including a mathematical model of excitation of a neural network and analysis of its properties by an analog computer, ferrite memory developments and applications, a review of research data on the rare earth element chalcogenides, and cavitation on propellers and hydrofoils. Also included are science and technology notes on a model of the universe with a homogeneous magnetic field, the internal energy of ball lightning, conjectures on the Luna-9 flight, long range propagation of ultrashort radio waves by ionospheric scattering in the subpolar zone, a Hall effect magnetometer, and forms of normal and anomalous color vision. In addition, the proceedings of conferences on automatic control, seismology, and the interaction of the ocean and the atmosphere are described. R.N.A.

N66-24942*# Washington Univ., St. Louis, Mo. Dept. of Economics.
EMPIRICAL EVIDENCE ON THE GEOGRAPHIC AND INDUSTRIAL DISTRIBUTION OF AEROSPACE EXPENDITURES
Robert A. Bohm Apr. 1966 60 p refs *Its* Working Paper no. 6528
(Grant NsG-342)
(NASA-CR-74770) CFSTI: HC $3.00/MF $0.50 CSCL 05C

The location subcontracting pattern and the interindustry requirements of the Gemini project are surveyed, as the basis for predictive hypotheses on the industrial and regional impact of subcontract expenditures. The data represent actual payments or expenditures to first tier subcontractors, with each subcontractor classified by state and industry. Input–output analytical techniques were used to organize the data and describe the Gemini program's interindustry impact. A state-by-state percentage distribution of the Gemini production function is presented, with the data indicating a definite pattern of subcontract location. These show that Gemini subcontracts are concentrated in a small number of industries, with electronics, instruments, and aircraft predominating. Subcontracts are also highly concentrated geographically, with California and Florida receiving a major portion. Details are given on the construction of an analytic model in which locational factors are used as the basis for predicting geographic interindustry impact for aerospace projects similar to Gemini. M.G.J.

N66-25011*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE FUNCTION OF DESIGN IN AN ADVANCED TECHNOLOGY INDUSTRY
W. J. Schimandel 27 Aug. 1962 23 p refs
(Contract NAS7-100)
(NASA-CR-74846; JPL-TM-33-101) CFSTI: HC $1.00/MF $0.50 CSCL 05I

This paper discusses an advanced technology industry and describes design as it exists in that industry. The characteristics of an ideal designer are presented and his development charted. These characteristics are then related to the training of students who intend to enter this profession. Author

N66-25196# Federal Aviation Agency, Washington, D. C. Systems Analysis Div.
SCHEDULED AIR CARRIER FLIGHT ACTIVITY IN THE UNITED STATES, NOVEMBER 1965 Interim Report

Ellen S. Reynolds Feb. 1966 39 p
(RD-66-14)

This report describes flight activity scheduled by commercial air carriers in the United States during November 1965. It contains flight data on all international scheduled air carrier flights originating or terminating in the United States and on virtually all domestic scheduled air carrier operations. Flight activity is described in terms of number of Friday flights by airline, aircraft type, hour of day. Author

N66-25203# Congress. House. Committee on Science and Astronautics.

AUTHORIZING APPROPRIATIONS TO THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Washington, GPO, 1966 145 p Committed to the Comm. of the Whole House on the State of the Union, 89th Cong., 2d Sess., 20 Apr. 1966, Rept. No. 1441 (H.R. 14324)

The text of the bill authorizing the NASA appropriations for FY 1967 is presented. Details are given on the objectives of each program, and the funding requirements needed to develop operational capabilities. The authorization, which totals $4,986,864,150, is allocated among 21 programs: Gemini, Apollo, advanced missions, physics and astronomy, lunar and planetary exploration, bioscience, meteorological satellites, communication and applications technology satellites, launch vehicle development, launch vehicle procurement, space vehicle systems, electronics systems, human factor systems, basic research, space power and electric propulsion systems, nuclear rockets, chemical propulsion, aeronautics, tracking and data acquisition, sustaining university program, and technology utilization. Funding for construction of facilities, and administrative operations is also included. The Committee's views during deliberations on the appropriations are summarized, and dissenting comments by committee members pertaining to geographic distribution and management procedures are presented. M.G.J.

N66-25319# Congress. Senate. Committee on Aeronautical and Space Sciences.

NASA AUTHORIZATION FOR FISCAL YEAR 1967

Washington, GPO, 1966 740 p Hearings before Comm. on Aeronautical and Space Sci., 89th Congr., 2nd Sess. on S. 2909, 28 Feb., 1–4 Mar. 1966
GPO: $2.25

This report presents the hearings before the Senate Committee on Aeronautical and Space Sciences on a bill to authorize appropriations to NASA for research and development, construction of facilities, and administrative operations during fiscal year 1967. Included are statements concerning the overall policy decisions made by NASA in connection with the funding of major programs; the highlights of the NASA program, schedules, and the general direction of agency planning; overall policy considerations underlying recent organizational changes within NASA and NASA personnel requirements; and a review of the bases for legislative changes. R.N.A.

N66-25321# Congress. House. Committee on Science and Astronautics. Subcommittee on Manned Space Flight.

NASA AUTHORIZATION, 1967, PART 2, NO. 4

Robert C. Seamans, Jr. et al Washington, GPO, 1966 1266 p Hearings before Subcomm. on Manned Space Flight of the Comm. on Sci. and Astronautics, 89th Congr., 2d Sess. on H.R. 12718 (Superseded by H.R. 14324) 18, 24 Feb., 1–3, 31 Mar. 1966
GPO: $3.75

This report presents the hearings before the House of Representatives Subcommittee on Manned Space Flight concerning NASA's authorization request for the fiscal year 1967. The Manned Space Flight management is reviewed, the status and planned activities of the Gemini and Apollo programs and the advanced manned mission studies are reported, the schedule for accomplishing specific objectives is outlined, and the funding requirements to continue the Manned Space Flight program for the next fiscal year are given. R.N.A.

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—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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